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*Special Issue*: A Life with Birds: Percy A. Taverner, Canadian Ornithologist, 1875–1947 JOHN L. CRANMER-BYNG

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# The Canadian Field-Naturalist

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Cover. John Macoun (left) and Percy Taverner (right) on a field outing, probably upriver of Chaudière Falls, Ottawa, in June 1911. The photographer may have been C. H. Young. (Reproduced courtesy of the Canadian Museum of Nature, number J-5535).

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# A Life with Birds: Percy A. Taverner, Canadian Ornithologist, 1875-1947

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From 1911 to 1942 Percy Taverner was Ornithologist at The National Museum of Natural Sciences in Ottawa, now called The Canadian Museum of Nature. He helped lay the foundations of scientific ornithology in Canada by building up the necessary collections of birds at the museum, and studying their distribution, working through a network of people who collected specimens and gathered ornithological information from across the country. He was a leading advocate of the need for conservation and wild bird protection, and played a major role, through his research and recommendations, in the creation of a national park at Point Pelee, and bird sanctuaries along the North Shore of the Gulf of St. Lawrence and at Bonaventure Island off the southern coast of the Gaspé Peninsula. Perhaps Taverner's most far-reaching contribution was as an educator of public thought. His wide knowledge was passed to the public in his books, *Birds of Eastern Canada* (1919), *Birds of Western Canada* (1926) and *Birds of Canada* (1934). He presented scientific information about his birds in their many plumages and habitats, and at the same time conveyed to the reader his own sense of appreciation of the birds he was describing. In this way he helped to make the study of birds and their habitats popular recreation. He was an active council member of the Ottawa Field-Naturalists' Club and an influential Associate Editor and frequent contributor to *The Canadian Field-Naturalist*. Throughout his life and career, his consistent devotion to the study of birds and their behaviour, his achievements and difficulties at the National Museum, his bird expeditions to different parts of Canada, and his family life, show a warm-hearted person with a sense of humour who was a tireless writer of letters to his many friends and colleagues.

Key Words: Percy Algernon Taverner, 1875-1947, ornithologist, National Museum of Canada, 1911-1942, Birds of Canada.

## Preface and Acknowledgements

Sometimes, by chance, something happens quite unexpectedly to cause you to take a turn in a new direction. This is what happened to me in May 1981 at the Federation of Ontario Naturalists' Annual Meeting at the University of Western Ontario, London. When registering we were each given a book called *W. E. Saunders – Naturalist*. This contained several photographs, one of which was of W. E. Saunders talking to his old friends J. H. Fleming and P. A. Taverner, both well known ornithologists of their time. Fleming donated his large collections of birds and ornithological books to the Royal Ontario Museum in Toronto. Taverner held the post of ornithologist at the National Museum of Canada from 1911 until his retirement in 1942. Also, he wrote the first book about most of the species of birds likely to be seen in Canada — P. A. Taverner *Birds of Canada* (1934).

In the photograph Taverner appeared as a tall, rather distinguished looking man with a neatly trimmed beard and moustache. Something about him, and his cheerful looking friends, made me want to know more about him. The photograph showed that it was taken at the meeting of the American Ornithologists' Union at Charleston, South Carolina in 1937 (see page 183).

When I returned to Toronto I looked for a biography of Taverner, but I was disappointed, there was none. All I could find was a substantial "obituary" notice in *The Auk* of 1948, but this gave me enough information to confirm my resolve to find out more. From this point onwards I was committed to Taverner the ornithologist, and Taverner the person.

Early in the 1980s my own future was of imminent retirement, and ideas already in my mind began to take shape. Here was this ornithologist without a

biography, and here was I, a historian at Toronto University soon to have time and energy to spend on a project of my choice. My professional training as a historian, and a long standing fascination with birds, persuaded me to join my two life interests and attempt to write a biography of P. A. Taverner.

A preliminary search showed that there was indeed enough material for a biography, but it was not until I had made a survey of the mass of Taverner material in the National Museum, Ottawa, and the Taverner papers in the Royal Ontario Museum, Toronto, that I realized the wealth of detail they both contained. As time went by it became clear that my task was to write about more than the life of one Canadian ornithologist. It must include a look at events, personalities and achievements that were part of the development of ornithology in Canada in the first half of the twentieth century. What started as a pastime during the early years of retirement developed into a challenge which has taken up the best part of ten years.

Taverner wrote well in the mass of letters, articles and other items that he wrote. But he had one weakness — erratic spelling. The same was true of his friend J. H. Fleming. Rather than retain Taverner's spelling mistakes and typing errors these have been corrected for the sake of clarity.

It would have been beyond my abilities to write adequately about the ornithology in Taverner's life had I not been fortunate to receive help and guidance from many ornithologists, professional and amateur, without whose encouragement I could not have completed this work. I wish to thank a number of individuals and institutions for invaluable help. W. Earl Godfrey, Henri Ouellet, Michel Gosselin and Stewart D. MacDonald at the National Museum of Natural Sciences, Ottawa (now the Canadian Museum of Nature) gave me much help and encouragement, and made my visits to the ornithology department a pleasure. I am particularly grateful to Earl Godfrey for his insights into the career challenges faced by his predecessor and invaluable advice in clarifying my attempts to realistically portray Taverner's professional life. The staff of the National Archives of Canada, private manuscript and government record groups, gave me much help. Ross James, of the Royal Ontario Museum, Toronto (ROM), read my entire manuscript twice, and not only reviewed bird names but also offered helpful editorial comments. To him I am extremely indebted. At the ROM I was given every assistance to work in the museum library and archive. I take this opportunity to sincerely thank Julia Matthews and staff of the library. Heather McCallum and staff of the Metropolitan Toronto Library, Theatre Department, Taverner Collection, were also helpful to my work.

At the time when I began my research I came into contact and exchanged help with a number of others working on biographies of Canadian naturalists. In particular I wish to thank Marianne G. Ainley who was beginning a life of William Rowan, for the stimulating discussions we had on our research subjects; also W. A. Waiser who was writing a life of John Macoun, and Richard Mackie who was working on a biography of Hamilton Mack Laing.

People who helped me to find information about Taverner's home life were his stepson, Karel Wiest, with whom I had two meetings just before he died, Corwin Ferguson, a relative of Karel Wiest, and Marthe Kent (nee Wiest); family friends who gave me useful information were Jean York, Anne Whitmore, Barbara Reynolds, Stuart Jenness. Especially I wish to acknowledge the considerable information I have received about Taverner family life from Karin Lumsden (nee Porsild), and Elizabeth Lloyd whose help and encouragement I gladly acknowledge.

People to whom I am grateful for the opportunity of discussing Taverner's career: Daniel F. Brunton, Harry Lumsden, Martin K. McNicholl, and Robert B. Stewart. Other people whose assistance was of importance to me are: Lise Anglin, A. W. F. Banfield, Fred Bodsworth, H. Deichmann, C. Stuart Houston, Trevor Levere, Farley Mowat, and Angus H. Shortt. Special mention should be made of Terry Shortt and Louise de Kiriline Lawrence who generously shared their memories of Taverner with me before they died.

Lastly, to my wife Margaret, who has prepared my manuscript for publication, from start to finish, and who shares with me a love of the natural world. To her this book is dedicated with affection and admiration.

## Introduction

The year 1926 was an interesting one for some ornithologists in North America. In that year the American Ornithologists' Union (AOU) held its 44th annual meeting for the first time in Canada. The chairman of the committee in charge of local arrangements in Ottawa was Percy Taverner, Ornithologist at the National Museum of Canada. For three years previously Taverner and his bird-artist friend Allan Brooks who lived in the Okanagan Valley, British Columbia, had been working on an illustrated book titled *Birds of Western Canada*. When the AOU accepted an invitation to hold its annual meeting for 1926 in Canada Taverner and Brooks planned that the print-

ing of their book should coincide with the AOU meeting in Ottawa.

The meeting began early in October with business sessions in the banquet room of the Chateau Laurier hotel. The presentation of scientific papers occupied three days and was held in the National Museum. In addition to papers there were several exhibitions of paintings, photographs and publications. The catalogue of paintings included 440 items by about 50 artists. On registering, each member was presented with a copy of Taverner's handsomely illustrated *Birds of Western Canada*, given courtesy of the Canadian Government as a souvenir of the occasion.

The dinner, held at the Chateau Laurier Hotel, was attended by about 180 guests and was an occasion for fun, much of it thanks to the sharp mind of Percy Taverner. After the formal proceedings about 60 people went on an excursion by motor bus to the Gatineau Hills. On arrival the majority of the members walked to the top of King's Mountain to enjoy views of the fall colours, while the remainder visited the grounds of the summer home of the Right Honourable W. L. Mackenzie King, Prime Minister of Canada.

The AOU meeting was a prestigious event for Canada's capital and the National Museum. For Taverner it presented a challenge which he faced with enthusiasm, humour and hard work. It gave him the pleasure of renewing his circle of ornithological contacts, and of knowing that *Birds of Western Canada*, his second book, would immediately reach an informed audience. It was a high point in his career.

Taverner's chief work at the museum was to build up a collection of specimens, birds mounted for display in galleries, and skins arranged in drawers for research purposes. He started with about 5000 specimens which had been collected by John Macoun of the Geological Survey. Taverner made a number of field expeditions to various parts of Canada, including the St. Lawrence estuary, the prairie provinces and British Columbia. He also employed younger men such as Dewey Soper and Mack Laing to undertake collecting expeditions for the museum, one of which resulted in the discovery of the nesting grounds of the Blue Goose on Baffin Island by Soper in 1929. When Taverner retired in 1942 the collection numbered 35 000 specimens including many series showing specific variations and geographic ranges of Canadian birds. It was this collection which served as the basis for Taverner's books and many articles, and the range maps which he devised where his skill as a draftsman was seen to advantage. A major contribution to Canadian ornithology was his method for showing the distribution of birds across Canada. Large topographical maps in a binder were kept on a table where bird records were plotted. The information from each was recorded on cards arranged by species, and this is still consulted by ornithologists today.

Taverner also made an important contribution to the conservation of wildlife and its habitat through his involvement in the stuggle to protect migratory birds in North America. In 1915 he presented recommendations to the federal Commission of Conservation for the creation of national parks at Point Pelee, and at Percé Rock and Bonaventure Island off the Gaspé Peninsula. In support of the recommendations he made a study of the stomach contents of the Double-crested Cormorants nesting on Percé Rock. He also made a study of the gannets nesting on Bonaventure, published in 1918, which contained a strong plea that the island should be preserved permanently as a bird sanctuary. Percé Rock and Bonaventure cliffs were declared federal migratory bird sanctuaries a year later. In addition Taverner was one of several dedicated ornithologists who encouraged amateur collectors of birds' eggs and skins to change their hobby and instead become students of the life histories and behaviour of birds. This led to the growth of the recreation of bird watching.

Another far reaching contribution made by Taverner was in stimulating the general public towards an interest in birds and an understanding of how they live in the wild. He did this by a series of handbooks beginning with *Birds of Eastern Canada* 1919. Here he was ahead of his time in using "field marks" as an aid to telling one species from another in the field. He had the ability to combine scientific information with an appreciation of birds in their many plumages and habitats. *Birds of Eastern Canada* was so successful that Taverner was asked to produce a companion volume *Birds of Western Canada* 1926. Later he amalgamated the material in the two books and produced *Birds of Canada* 1934.

The name P. A. Taverner was well known in Canada during most of his career because of his three books, and even after his death his name continued to be known for another 20 years or more until a completely new book, *The Birds of Canada* by Earl Godfrey, was published by the museum in 1966.

Since he was well known among naturalists across Canada for over 50 years, why has no biography been written about Percy Taverner until now? Near the end of his life an ornithological colleague at the Royal Ontario Museum, Ontario, suggested that Taverner should use his retirement to write his autobiography. Taverner replied, "I do not feel that there has been enough of general interest in my life for an autobiography". His judgment that the story of his life was not sufficiently interesting for a book may have been correct in the mid 1940s when the Second World War was coming to a climax. But now, 50 years later, when bird watching has become increas-

ingly popular and when preservation of habitat and biodiversity have become issues of global concern, his biography should be of interest to a wide public.

Taverner was one of the ornithologists of the 1920s and 1930s who played a major part in making the study and enjoyment of birds and their habits a popular recreation. In this he was in the first rank, and as a museum builder he was way ahead of the facilities available to him.

# Part I — Early Years

## CHAPTER 1. Percy Fowler

A boy was born in the small town of Guelph in southern Ontario on 10 June 1875. His father, Edwin Fowler, was principal of a private school in which his mother, Emily Buckley, taught.[1] The child was christened Percy Algernon at St. George's Anglican Church, Guelph.[2] Information on the background of Percy's mother and father is meagre. Few of the details usually available to a biographer about the subject of his study are available in this case.

For information on his first years there are only two sources based on family reminiscences. One is a typed, four-page "Biographical Outline" compiled by Taverner himself, in which he said nothing about his parents except that he was "of English born parentage on both sides".[3] The other source is a nineteen page "In Memoriam" notice written by W. L. McAtee, a longtime friend, printed in *The Auk* soon after Taverner's death. According to this account, Percy's mother was a survivor of the great Chicago fire of 1871.[4] Some information can be gleaned from a few newspaper articles written about him and from a few snippets of information embedded in Taverner's extensive ornithological correspondence which has been preserved. But almost no "family" letters appear to have survived.

A feature article about Taverner that appeared in a Toronto newspaper in 1944 gave the information that his mother "had been a child in school in Chicago at the time of the fire, lost her home and entire family in the disaster but had stayed on at her school and eventually taught there."[5] Another scrap of information comes from a series of articles on Percy Taverner, his mother and his sister written for an Ottawa newspaper in 1958, eleven years after his death. According to this source his mother was born in Manchester, England, and emigrated to Canada when very young.[6] As a result of this clue I was able to obtain a copy of her birth certificate from England, which gives her year of birth as 1854. Her father, George Buckley, was shown as a "book keeper" (clerk).[7] Using this information I attempted to trace Emily Buckley's family in Chicago but without any success. Chicago's records of this period are incomplete and difficult to trace. Some were destroyed in the fire of 1871; thus there are no documents to corroborate the statement that Percy's mother was orphaned during the Chicago fire, and no evidence to show that her family lived in Chicago.

Information on Percy's father is equally vague. If Emily Buckley was at school in Chicago in 1871 but was in Guelph in 1875, how and why did she make the journey from Chicago to Guelph? One possible explanation is that Edwin Fowler was living in Chicago during this period, that he met Emily Buckley, and that together they went to Guelph. A search of the Chicago records seemed promising. According to the U.S. Census returns for Chicago in 1870 a man by the name of Edwin Fowler was living in Ward 12. This man was born in England, was twenty-eight years old, and had a wife, Mary Fowler, who was twenty-one years old and was also born in England. In the Chicago *Street Directory* for 1871 he was shown as a teacher at Dyhrenfurth College, a business school. In the 1873 *Directory* he was listed as superintendent of the college, and as boarding at 160 North Carpenter. The last mention of Edwin Fowler in the Chicago records was in the 1874 *Directory,* where he was shown as residing with the president of the college, Julius Dyhrenfurth, at 160 North Carpenter.[8]

According to an account of some of the private schools in Guelph in the nineteenth century, a boarding school known as the Guelph Academy was sold to Edwin Fowler, B.A. This account states he had attended Oxford University.[9] My enquiry about Edwin Fowler addressed to the registrar of Oxford University received a negative reply. "I have searched our records for the nineteenth century but regret that I am unable to find that he was ever a member of, or obtained any degree from Oxford University."[10] The Guelph assessment rolls show that in 1874 Edwin Fowler took a three year lease of the Guelph Academy. The only Guelph city directory that mentioned Fowler was for the year 1875-76. The entry reads:

"Fowler, E. Principal Guelph Academy, 175 Woolwich St., h. same

Fowler, Mrs. E. directress ladies department, Guelph Academy." [11]

There is no record in either Chicago or in Guelph to prove that Edwin Fowler and Emily Buckley were married. But this means little. They might have been married in Chicago without any record of the marriage surviving. They could also have been married in Guelph without any record being preserved.[12]

An advertisement for Fowler's academy, printed in the *Wellington County Atlas* of 1877, gives as principal Edwin Fowler B.A., and as directress Mrs. Edwin Fowler; it lists three members of staff by name. The school had facilities "for both sexes in Classics, Mathematics, Languages, English, Drawing, Painting etc. Boarders received and students prepared for College."[13] Apparently Fowler's Academy was well regarded.[14] Hugh Douglas, writing in 1960, stated that "Elderly ladies have told me that Mrs. Fowler deserted her husband, went to New York, and became a well known actress on the Broadway stage. Her stage name was Ida Van Cortland."[15] This was not mere gossip, though the reference to Broadway is an exaggeration. This account implies that Emily Fowler was to blame for deserting her husband and "going on the stage". It is true that in 1877 Emily Fowler joined Mrs. Morrison's Stock Company in Toronto where she first took a part as a member of the ballet.[16] Not until near the end of Percy's life was there an indication that anyone who had known his parents was still alive. In a letter to an old friend, Hamilton Mack Laing, Percy mentioned that he had received a letter from Mrs. Sharman.

> "Of course I never met her personally but she seems to be the only one I know of who knows anything of my early days and forbears. She must be a remarkable personage, at her age to retain such interests and clear faculties. Her writing and letters are those of a young woman. Strange too how different life lines cross. Not only did she know my mother as a young woman but also is closely connected with other people who fortuitously had a great influence on my life."[17]

Soon after Percy Taverner died, Mrs. Sharman wrote to Mack Laing mentioning his earliest years. In doing so she let slip the only information about his parents that now exists:

> "... the recollections of myself a twelve year old girl pupil — flashes of memory — of charming people who were unsuited to one another — seem better left with Mrs. Taverner, who could if she thought best, add what she pleased."[18]

But Taverner's widow left no information on his earliest years. It seemed to have been a closed subject to his mother, his half sister and his wife.

Percy Taverner had an unpromising start in life — parents who parted when he was two years old, a father whom he never saw again, and a mother who, at the age of twenty-three, started a career on the stage in order to support herself and her infant son. But Ida Van Cortland, as she now called herself, had intelligence and character, qualities that were to sustain her in the ups and downs of life which she and her son had to face. This is the subject of the next chapter.

## CHAPTER 2. Percy Taverner

When Emily Fowler came from Guelph to Toronto she found employment as a member of Charlotte Morrison's stock company playing at the Grand Opera House.[1] At that time Toronto was a city of about 250 000, with several theatres which provided a certain amount of cultural entertainment. Whether Emily had any friends in Toronto is not known but she was young, had a good figure and attractive looks, as well as considerable vivacity and intelligence. Under the stage name of Ida Van Cortland she soon began to play small parts. In a stock company novices learned how to act while on the job by watching rehearsals, and by studying the technique of visiting "stars" who played the leading roles. Her first chance to speak a few lines came in September 1877 in a production of *As You Like It*. By the end of the season Ida had played as many as forty different small parts.[2]

When Mrs. Morrison's company disbanded in the summer of 1878 owing to financial problems Ida went, with a letter of introduction, to seek work in New York. She became a member of William Nannary's company on a tour to Atlantic Canada in January 1879, and began to receive favourable press notices.[3] In September a young actor called Albert Tavernier came from New York to join the company. He was the same age as Ida and had started his own career in the theatre at the same time as her, but in Cleveland, Ohio. His father, Joseph William Taverner, was a well known teacher of elocution and dramatics who coached several famous public speakers. His son, therefore, had a good start for the theatrical profession.[4] Albert was handsome and personable. Ida and Albert fell in love. At the end of the year the Nannary Company disbanded and they both returned to New York to find employment. From August 1880 to April 1881 Ida toured in the northern and southern States while Albert acted in various New York theatres. In June 1881 Albert Tavernier and Ida Van Cortland were married.[5]

Following their marriage they toured for a season with W. J. Florence and his wife in *The Mighty Dollar*, and a few other plays. Florence's performance as an ignorant and self-seeking politician in *The Mighty Dollar* was an excellent character study which Albert adopted later as a model for his own interpretation of the part.[6] In 1883 Albert and Ida decided that the organizational side of the theatre was changing so rapidly that touring companies had now supplanted resident companies, and that the future lay with touring companies presenting a few well chosen and well presented plays. They made the bold decision to set up their own company, with Ida as the leading lady and Albert as actor-manager.[7]

Meanwhile, little Percy had an unsettled childhood, travelling from place to place with his mother and learning his first lessons from her. When she married again Percy was informally adopted by his stepfather and exchanged the name Fowler for that of Tavernier.[8] His earliest connected memories were of a private kindergarten school at Highland Falls, near West Point, New York where he boarded with a few other children for one fall, winter and spring. These memories concerned natural objects such as the first spring flowers, watching orioles at their nest in a tree in the front yard, and monthly numbers of a magazine in which there was a story about a naturalist and a Scarlet Tanager with a picture of the bird.[9] It is likely that Percy attended this school from the fall of 1881, when his mother and stepfather left New York to tour with the Florences' company, until their return in the spring of 1882. This would be during Percy's sixth year since his seventh birthday occurred in June 1882. The earliest photograph of Percy to have survived shows the head and shoulders of a small boy of about six years old, his hair neatly brushed, wearing a smart polka-dot shirt and a matching tie. This photograph might have been taken for his mother to have with her while on tour.[10]

The Taverniers' big venture began in August 1883 with their own company, the New York Comedy Company.[11] Each season the Company would start in the fall on an itinerary which would last until some time in the following summer. One season they toured the Atlantic provinces and states; another season they would tour mainly in southwestern Ontario and the Great Lakes.[12] The visit of a touring company, especially to towns in rural areas, was a local event. Members of the Company brought with them a touch of a wider world, a hint of elegance and culture, and on the stage the drama of passion, of anger, of sorrow. Colourful costumes, music and well spoken words roused members of the audience from the routine of their narrow lives. The local newspapers reported the performances of visiting companies as did the *Dramatic Mirror*. On the whole the Taverniers' Company received favourable notices. Albert and Ida were seriously involved in their profession; they wished to provide quality entertainment, well acted, well spoken and productions that were well dressed. They consciously aided this image by attending church on Sundays, giving benefit performances for local causes, attending civic functions and even producing plays written by local amateurs. In this way they aimed to establish a "home audience" in the towns they visited so that their annual appearance was an event for their audience to look forward to.[13] Percy's earliest memories were of travelling on circuit with the company — of temporary residences with a theatrical family in Halifax, with a family in Brooklyn, and with a minister's family by the Erie Canal.[14]

By the summer of 1885 Percy had turned ten years old and his mother sent him to a private school in Port Huron, Michigan. Here he boarded with a Mr. and Mrs. C. F. Smith and their children who treated him as one of their own.[15] But however kindly he was treated it would have been impossible to make up for not having a father and the lack of a permanent home with brothers and sisters and cousins of his own. However, this was soon to be remedied.

Albert's father, Joseph William Taverner, the professor of elocution, died intestate in Jamaica in 1885. Among his assets was an island in Lake Muskoka opposite the holiday resort of Beaumaris.[16] Since he left no will, possession of the island would have to be divided equally between his two sons, Henry W. of San Francisco, and Joseph E. of Mount Vernon, N. Y., and his five married daughters. Rather than do this his heirs worked out a family agreement by which each one relinquished their share in favour of Ida Tavernier in return for five hundred dollars Canadian money to be paid by her. No family papers have survived to explain why the island was sold to Ida only, rather than to Albert and Ida jointly. All that exists is the original deed of sale.[17] Albert and Ida with Percy first visited the cottage on the island for one night in the summer of 1886.[18] At least Percy could now look forward to summer holidays at a cottage on a lake, and this should have given him a feeling of belonging somewhere.

Another change occurred in Percy's life when his mother withdrew from the Company's tour early in 1887 due to "an approaching domestic event" as the *Dramatic Mirror* delicately phrased it. In June 1887 she gave birth to a daughter in the town of Markham north of Toronto.[19] Percy now had a half-sister, Ida, 12 years younger than himself, with whom to share family life, especially in the summer holidays. Presumably Percy's mother went to Markham for the birth of her child because her sister-in-law, Florence Knill, with her husband Edwin G. Knill who was a physician, lived there. They had a young family of their own, and some years later bought a one acre lot on Gibraltar Island.[20] Ida grew up with first cousins who came to stay near to her family in the summer.

During the late 1880s the Tavernier Company was becoming well known and drawing reasonably good audiences and receiving good notices. The theatre business was growing at this period owing to an expanding population and the growth of cities. Communications were improving with the network of new railway lines that was being laid out. All this made for a greater demand for theatrical performances, which in turn caused an increase of competition. The Taverniers managed to keep abreast of this by playing the lucrative Great Lakes circuit, especially in the cities where they were always well

Taverner family photo taken at Ann Arbor, Michigan, 1889. Percy age 13, Ida Clare age 2 (Courtesy of the Metropolitan Toronto Reference Library, original in the collection of Murray Edwards).

received such as Hamilton and Toronto.[21] Although in the late 1880s they were doing well in the public's estimation artistically, the account books show that financially they were not all that prosperous. Their finances were not improved when Albert Tavernier indulged his ambition to be an actor-manager by taking a five-year lease on the Hibbard Opera House in Jackson, Michigan. Apparently this was an unprofitable venture and he had to give up the lease after only one year.[22]

In the summer of 1889 Percy turned fourteen and it was time for him to go to high school. His mother and stepfather must have given some thought to his future education and a possible career. One thing was certain — with his stammer he would never want to become an actor.[23] It was decided that he should prepare for entry into Ann Arbor High School, probably because it was recognized at that time as the leading high school in the state of Michigan. It was established in 1856 largely to prepare students in Ann Arbor for the University of Michigan. The relation between Ann Arbor High School and the university was close, and a number of university teachers also taught at the school.[24] Many students from outside the city enrolled in order to take advantage of its connection with the university. Board and lodging with families in the town was available and Percy lived with the family of Wallace Bliss. A portrait in sepia of the Tavernier family taken by a photographer of Ann Arbor in 1889 exists showing his mother on one side of a chesterfield, his stepfather on the other side and little Ida Clare, aged two, in the middle. Percy is standing behind, his hair cut short, looking straight at the camera with his eyes fully open and his mouth a fraction open. It is a non-committal look, as though he may be about to break into a smile, or that he may not trust the photographer.[25] Percy attended grade eight in Ann Arbor for one year before entering the High School in the fall of 1890. Ann Arbor High was an imposing imitation Gothic building of undressed stone and brick with turreted slate roofs which blended well with the "academic" Gothic architecture of Michigan University in the 1890s.[26]

We know nothing about his time at high school either from Percy or from his family, and can only adduce a little information from the Ann Arbor High School "Catalogues".[27] These show that Percy A. Tavernier was enrolled in the First Year program in 1890-91, and that the student enrolment for that year was 200. He attended the Second Year program in 1891-92 and the Third Year in 1892-93. The catalogue for that year showed that he was in the English course. Students in this program would be required to take five science courses, two of which must be in botany and physics. The other three courses could be chosen from: astronomy, chemistry, physiology or another full course in physics. What was not offered was biology, a subject that would have been very useful to Percy in the future had he been able to study it. In this program two years of Latin, French or German could be taken instead of Physiology, Chemistry, Astronomy, and English History. French would have been useful to him in later life if he had chosen to take it at Ann Arbor High. Other subjects included were: Arithmetic, Algebra, Geometry, English Literature, Old English, Grammar, History. Programs required four years of study in order to obtain a diploma that would admit students into the University of Michigan. One major problem Percy would have faced in high school was that much of the class work was heard orally in daily recitation periods. In this he would have been at a disadvantage. Moreover, in his third year he would have been required to take "rhetoric". If this meant "skill in the effective use of speech" and required practice in "verbal communication" then Percy would have been at a double disadvantage. The school encouraged participation in various extra-curricular activities such as those of the literary society in "speaking, discussion, and parliamentary practice", as well as a society for debating and dramatics. Ironically none of these activities would have been ones in which Percy could have participated satisfactorily, except perhaps as a stage hand.

There is no evidence that Percy took any part in football or athletics though there is plenty of evidence from the annual year book of that period, *The Omega*, that students took part in sports of various kinds. In fact no records appear to have survived concerning Percy's school days at Ann Arbor High. It was almost as if there was nothing he wished to record or remember from that period. We can only guess that because of his stammer he may have felt "out of things". One of the rules laid down by the school board stated that "Hazing, rushing, pumping, concerted riots, and disorderly conduct on the street, or on the school or public grounds shall subject pupils to suspension; and certificates of graduation may be withheld from any pupil ... engaging in such practices."[28] A boy such as Percy was likely to have been subject to some form of ridicule simply because his speech sounded comic. This may have had the effect of turning him into a "loner" at that time.[29]

Luckily young Taverner took up a recreation that he could enjoy in a quiet, uncompetitive way. What exact year he became interested in the study of birds is not clear but it was certainly before May 1893 when he began to keep regular bird notes. He probably started by collecting birds' eggs as most boys did in that period. One day, just by chance, he met a man on the street who happened to be A. B. Covert the taxidermist of the University of Michigan Museum. When Covert realized that the boy was seriously interested in birds he invited him to come and see

what went on behind the scenes in the zoology section of the Museum. Here he met two other young men with the same interest — George Prey and Robert Walcott, who were constantly in the field together collecting birds for study. This was probably in 1892 when the Museum was busy making a Michigan natural history exhibit for the World's Columbian Exhibition to be held at Chicago in 1893. The scene inside the Museum was "entrancing" and Percy gradually became interested in the more serious side of bird study.[30] Covert taught him the rudiments of taxidermy, and Percy became a constant visitor at the Museum and an unofficial, unpaid assistant. In this way he began to develop a systematic knowledge of birds and an appreciation of their qualities. On weekends and holidays he was outdoors birding with two or three others with the result that his spare time was happily filled and he got enough exercise by tramping the countryside around Ann Arbor. By the time he began keeping a notebook he had already gained experience through collecting birds and he knew that his ambition was to be a student of ornithology. Although he never studied ornithology at the University he did study it unofficially behind the scenes in the university museum.

Percy Taverner approached his chosen recreation in the spring of 1893 with seriousness as can be seen from the "Preface" he wrote for his first book of bird notes. This, he explained, was to be a daily record of his collecting trips with anything he felt worth recording such as the weather, early spring arrivals, early eggs, and rare birds identified. In a second book he proposed to list the birds he saw *by species* showing year and place together with notes taken from his first book on what he had observed of their behaviour. In a third book he intended to keep statistics such as arrival and departure dates on migration, length of incubation of eggs, and information on what food a bird had been eating after he had dissected it. As a result he hoped to classify all his notes in a way that would make it easy to find anything that he might want. His notes would be useful for his own education. He began book 1 with some cautions that he intended to carry out. These were safety precautions about handling a gun in the field "that I have learned by experience."[31] But first he cautioned himself about his purpose. "Never forget you are a student, not a mere 'collector'." Then followed twelve points about hunting birds with a gun such as "never fool with a gun whether it is loaded or not; never point your gun at any living creature unless you want to kill it; learn to handle a gun carefully from habit." Someone at the Museum had trained him well. But in addition he was well aware that birds are living organisms not just museum specimens that have been killed for identification purposes. "Remember ornithology is not a dry study it is full of life and poetry and beauty", and he advised that one should study a newly killed bird as it lay in one's hand before it is skinned.

One should try to imagine it in its native tree tops. A quarter of an hour of this would give one a truer idea of the bird's build than a week of measurements. This was revealing of Percy's attitude towards birds and their study one month before his eighteenth birthday.[32]

The first entry in his bird notes was made on 7 May 1893 walking down the Ann Arbor river when he recorded: White-throated Sparrows; Maryland [Common] Yellowthroat; Chewink [Rufous-sided Towhee]; Yellow Warbler; [Eastern] Kingbird; Rose-breasted Grosbeak; Carolina Rail [Sora]; Long-billed [Louisiana] Waterthrush; stake driver [American Bittern]; Florida Gallinule [Common Moorhen].[33] Two days later he recorded a Scarlet Tanager, a Red-headed Woodpecker, a Blue-gray Gnatcatcher and some Bobolinks. From this time until 1910 Percy would spend much of his spare time walking the fields and marshes, forests and shores observing, collecting and recording. A week later he was out with Covert and Walcott when an uncommon bird was collected which was identified as a Yellow-throated Warbler. Although he was able to examine it closely in the Museum he missed the great satisfaction of identifying an uncommon bird alive in the wild.[34] At Four-mile Lake near Dexter in late June he recorded six nests of Least Bittern, one of which had a set of six eggs. Meanwhile his mother and stepfather were on Gibraltar Island for a week in May 1893 preparing for a three-month summer season at the Silurian Casino in Waukesha County, Wisconsin, the site of a health spa.[35] Percy's bird records show that he probably visited them at the spa in July 1893 when he recorded seeing a Pied-billed Grebe at Grass Lake in Waukesha County. From early August until mid-November he was staying on Gibraltar Island, and recorded shooting partridge [Ruffed Grouse] from time to time.

By now Percy had completed three years at Ann Arbor High and had turned eighteen in June 1893. But his movements during the school year 1893-94 are not clear. He remained at Beaumaris until mid-November which may indicate that he returned to Ann Arbor late for some reason.[36] According to his bird notes he was at Ann Arbor in the first half of 1894. He described the nuptial display flight of a male Marsh Hawk [Northern Harrier] observed on 25 April which shows that his powers of observation were sharp and that already he had developed a clear style in writing English with a pleasant rhythm to it. "He would fly along about twenty feet from the ground and then suddenly drop down, turning over and round, sometimes on his back and sometimes on his side, until within five feet of the ground when he would rise again and do it over again. All this while uttering a low gurgling note. After a while he sailed

off and was joined by his mate."[37] In mid June he was birding with Covert and Walcott southward along the railway track in Ann Arbor and found a nest of young Bobolinks; a male Henslow's Sparrow, adult and young Chipping Sparrows and Yellow-breasted Chats.

According to the log-book at Camp Coo-ee Percy was there from July into November, while Albert Tavernier's sisters Clara from California and Daisy from Detroit occupied the house. The Knill and Power families also visited during the summer. Altogether there were four aunts, two uncles, and three cousins of Ida Clare's at the island during the summer. After the last relative had left Percy stayed at the Prowse's who owned the Beaumaris Hotel. In early November he went to live in Guelph where his stepfather had taken a two-year lease of the newly opened Royal Opera House as manager.[38] Percy was office boy, since he recorded in his notebook: "At five p.m. I closed the box office and taking a lunch for supper went up the Grand River until dark."[39] He made several trips down the local rivers and was out with his gun collecting birds on most days in May. From Guelph he went to Beaumaris where he spent the summer of 1895 with his mother, stepfather and stepsister Ida, now aged eight, and members of the Company. One of them had his mandolin with him and another had his guitar. On 28 June the Company played *The Mighty Dollar* at Bracebridge for the benefit of the orchestra while on ll June they played *Forget-me-not* at Rosseau. They then went to Parry Sound, twenty-four miles by stage coach, to play there for a week.[40] In July Mrs. Smith, with whom Percy had boarded at Port Huron, arrived to stay and they celebrated the "glorious fourth" with a picnic at Bala. "Had big time & got towed back by the supply boat and ended up the day by two immense bonfires. The Stars & Stripes very much in evidence." Another time Ida Clare and Mrs. Smith went with neighbours, the Fearmans, in their steam yacht "Iris" to Judge Mahaffy's. Someone held a "bee" and got his verandah up while the people at Solid Comfort Camp gave their "at home and annual jollification" which they all attended. In August there was a fancy dress "hop" at the Hotel and everyone at the camp went over in costume. Albert went as Bardwell Slote, a character in *The Mighty Dollar*.[41]

The summer of 1895 should have been a memorable one for Percy. He had a gun and a rowboat for recreation, plenty of social life, and no further anxieties about school. Whether or not he had any ambition to study at Michigan University is not known.[42] All we know is that Percy was a young man with no career in view. However, a temporary job was easy to find. When the Tavernier Company took the road for the 1895-96 season Percy accompanied it as assistant property man at $5.00 per week. Little Ida Tavernier was listed as one of the "artistes" and received $1.00 per performance. This season Ida Van Cortland was probably managing her own company which would have put a heavy load on her shoulders.[43]

The Company started the tour at Barrie in mid-September, was in Guelph for a week, then went to Ottawa followed by Sault Ste Marie, followed by Ashland (Wisconsin) and Brainerd (Minnesota), and then Winnipeg which was their furthest stop west. This was quite a challenge for Percy, not because of his job, but because of the continually changing opportunities for observing birds. His ornithological notes expanded considerably and while the others rested or rehearsed Percy went for a walk or "took a tramp". At Ashland he recognized an Arctic Three-toed Woodpecker [Black-backed Woodpecker], but did not recognize a sparrow with a suggestion of a crest. He made a passable watercolour sketch of it and considered it a Lincoln's Sparrow. At Brainerd he noted that the Ruffed Grouse on sale in the market were all of the grey variety. In Muskoka there were both red and grey colours. He shot two "sandpipers" which he could not identify. All he had to identify them with was Afsgar's pocket key and could only guess that they might be Robin Snipe [Red Knot]. At Winnipeg the first thing he did on arrival was to go to the shop of A. Hine and Sons, taxidermist, and get the local bird news. One thing he learned was that Whooping Cranes were reported to be common but so wary that they were hard to shoot. He saw three specimens for sale in Hine's shop. When he went on a hunt with one of Hine's boys he found that the Prairie Chicken [Greater Prairie-chicken] was very common "but so wild as to be impossible to approach."[44] An entry in his notes from South Dakota began: "There is a barber in town who is also a taxidermist. I have spent every vacant minute over at his shop ... I mounted two owls and a ruffed grouse for him and gave him some points on bird work."[45] The barber-taxidermist gave Percy skins of a Night Heron [Black-crowned Night Heron], Prairie Chicken [Greater Prairie-chicken] and Lark Bunting.

Percy's notes for 1896 start with a short self-examination. He wrote: "This begins another year with the birds. Have I learned anything in the last year? I think so. But such a little out of a great deal that might of [have] been learned." He decided that he should give special attention to drawings of parts of birds — head, bill, wings, tail, feet — with the object of getting information for the classification of birds by species, and also the relation of plumage to flight. Under an entry added to the Preface to his Ornithological Notes he noted that he had carried out the intention he wrote down in May 1893 as regards Volumes one and two and that he would call his illustrations "Volume three". He aimed to collect a picture of each of "our birds" signed, dated,

named and numbered with the American Ornithologists' Union Check-list number, and a sketch showing the distance between the point of the bill and the eye.[46] Although he did not have a guide book of any kind with him in the field, and certainly no bird illustrations, he did mention using a field glass, though this presumably would have been a single lens with low powered magnification and not good light. To be certain of identifying a bird correctly it was necessary to shoot a specimen and key it out. This is where measurements and sketches of the salient parts of a bird were useful. Percy took his specimens and drawings seriously, and went about it in a systematic way. To a great extent it was a question of learning from his own collection of skins, though he could continue to return to the Museum at Michigan University for specific information, referring to books, and learning from the experience of others.

At the beginning of February Percy left the Company in Iowa and visited Ann Arbor. While there he took the opportunity to look at Audubon's plates in *The Birds of America,* a copy of which was in the University Library. Percy was not over-awed by the great bird artist; in fact he wrote what he thought, or possibly what he had heard from others. "It is a big thing for a beginner to criticize Audubon but I think he is an over estimated man. The work shows an immense undertaking but a great deal of fault can be found with it. There is only one plate that really pleased me - a nest of Barn Swallows. The rest all show too little artistic value and idealization."[47]

From here he went to join Albert at the Royal Opera House, Guelph, where he looked for birds regularly in the spring. This included a trip to a local heronry. Percy and a friend wanted to shoot "fish cranes" [Great Blue Heron] as they were called and after much "soft soaping" the farmer on whose land the trees stood gave them permission to shoot three only. Apparently all the farmers owning land included within the limits of the heronry signed an agreement to allow no one on it because twenty-five or thirty birds had often been slaughtered "without rhyme or reason". As it turned out Percy only got two birds.[48]

Meanwhile Ida Van Cortland and the Company had traversed several mid-west states in winter and arrived in Detroit in May. They spent a month in Hamilton and arrived in St. Thomas late in July, where they had a good reception. "Business has steadily increased. W. J. Butler and Albert Tavernier are both great favorites, and the singing of Wilfred Lucas is always a much welcome number of the programme." *The Dramatic Mirror* announced that the Tavernier Dramatic Company would close its season at St. Thomas on 1 August 1896. It also said that Ida Van Cortland would spend the summer holiday at Beaumaris, Lake Muskoka, and that Miss Van Cortland would not star next season, but would likely accept an engagement.[49]

The log book of Camp Coo-ee, written in Percy's handwriting, shows that Albert came from Hamilton but stayed only two days. This was the last time that his name appeared in the log book. It was a sad but perhaps inevitable ending to the marriage, and partnership, between Albert and Ida. But Ida Van Cortland was now forty-two years old and her daughter, Ida Clare, was nine in mid 1896. Ida had to think seriously about Ida Clare's education, and about her own career. Albert Tavernier, although a congenial man and a good actor, had artistic tastes rather than business ability and his two attempts to become a successful actor-manager had failed. To succeed as a manager in the theatre in the 1890s one needed to be a businessman with capital. Albert appears to have worked hard and had no obvious vices. But the fact remains that the Tavernier Company made only a limited amount of money and that Ida's share would not be enough to support her once she ceased to act.[50] There seems to have been no sudden quarrel because they remained acting together until the end of the season of 1896. But they both had to think of the future. Albert Tavernier had to find another engagement. Ida took an engagement with Wait's Comedy Company which toured in New England during the season 1897-'98. Young Ida went with her mother.[51]

The only member of the family who had no work and no income for the future was Percy. He did a little taxidermy work locally until September when he got a commission to mount about thirty skins of New Zealand birds at Grimsby, Ontario.[52] This brought him close to Hamilton where lived Thomas McIlwraith, the senior ornithologist in Ontario at this time and a founder of the American Ornithologists' Union. Young Taverner called on old McIlwraith and they talked about birds.[53] Back in Beaumaris Percy had plenty of time to wonder about the drifting apart of his mother and stepfather, and the implications for him. The island, and the cottage on the point opposite Beaumaris, was still his mother's, a place where he and his mother and half-sister could always expect to spend a summer holiday. Otherwise the outlook was uncertain, as bleak, perhaps, as the weather of November in Muskoka country. Percy remained there as long as he could but when it grew too cold to stand, and the crossing from the island to the village by rowboat became too rough, and when he was down to his last few dollars he knew he had to go. The last entry in his bird notes was dated 12 November. He took the train to Toronto to face a new world without his small family and the extended family of the Tavernier Company to support him.

## CHAPTER 3. Getting a Start in Life

Percy Taverner first met J. H. Fleming in December 1896 when he came down to Toronto from Muskoka "broke and aimless". He was introduced to Fleming by James Grand of the firm of Grand and Toy, whom he had known for some years in Muskoka.[1] Percy hoped that Fleming would give him a job in the shop of Oliver Spanner and Co., taxidermists, on Yonge Street. Fleming, whose family seed business was on Yonge and Elm, just north of Spanner's shop, had a business agreement with Spanner. This was not as a financial investment but as a way of providing him with facilities for preparing his specimens and aiding his ornithological interests. Although involved in his family business his absorbing ambition was to form a collection of mounted birds and study skins on a world-wide scale.[2] In those days a taxidermist's shop was the meeting place for the shooting fraternity who brought in the trophies they wanted mounting, and the rarer specimens that they wanted identifying. Spanner's shop was a natural centre for the exchange of ornithological information in the Toronto region and Fleming was at the centre of it.

Although there was no job there for Taverner, for some reason Fleming took an interest in him and gave him the use of rooms above the shop. Looking back on this meeting Taverner wrote "I was a rather raw youth with more enthusiasm than knowledge and only vague glimpses of the great field ahead, and I have often wondered why he took an interest in me." The collection of water-colour drawings of birds Taverner had made in an amateur way may have roused Fleming's interest in him, "...perhaps he recognized some glimmerings of promise in my untrained ornithological enthusiasm."[3] Fleming was only three years older than Taverner but had been elected an Associate of the American Ornithologists' Union in 1893. The two young men developed a close friendship and collaboration which was to last until Fleming's death nearly 50 years later.

Taverner was also befriended in Toronto by W. G. A. Lambe, founder of a company of grocery brokers, an original member of the Argonaut Rowing Club, and a collector of birds' skins. He bought Percy's colour-wash drawings, and nearly every Sunday Percy had dinner either at the Flemings' or the Lambes'. He later recalled "From Lambe I was introduced to an old-world-like courtesy that I had not seen before". Both Lambe and Grand gave him "very material aid" for which he was always grateful.[4] Percy was a regular visitor to 267 Rusholme Road, the Fleming family home since 1892. Here, in front of the gold-fish pool in the greenhouse, cigars in hand, Fleming and Taverner sat and talked many times after Sunday dinner. From Fleming Percy gained his first broad view beyond parochial fields and was introduced to a wider outlook. Here they discussed ornithological standards and ideals. "From Fleming I gradually absorbed the foundations of scientific ornithology as it was developing at that time … It was as good, perhaps better than a university, at least it was more broadening."[5] Here, also, Percy could examine Fleming's nucleus of a collection, which already contained some interesting specimens, including birds from outside North America. By the time of his death in 1940, Fleming had built up one of the largest and finest private collections of birds in the world.[6]

By taking odd taxidermy jobs, and with the help of friends, Taverner managed to exist. All his spare time he spent at the shop in the company of Oliver Spanner, his assistant Fred Dippie, Fleming and anyone else who happened to be visiting. "Fleming usually occupied a chair in the corner keeping an ear open for the bell announcing a customer (or the game warden) downstairs, when he descended to attend to business or to pump a visitor for information..."[7] In this atmosphere, blue with tobacco smoke, they discussed many things, but mainly ornithological matters. Percy had fallen on his feet. Suddenly he was a member of a circle of kind and congenial men with whom he had something in common, and even his stammer ceased to matter much. Taverner was no outsider to the bird talk and anecdotes that flowed around him. He, too, had experiences of his own that he could relate, such as the September day at Beaumaris in 1894 when he shot a bird he did not recognize. He sent the skin to his mentor, A. B. Covert at Ann Arbor, for identification. Covert sent it to Robert Ridgway of the Smithsonian Institution who identified it as an immature male Greenland [Northern] Wheatear. Covert claimed that *he* had taken this specimen. The Smithsonian kept it and credited it to Covert.[8] Another bird record which showed that Taverner was a serious and knowledgable bird man was his letter published in the *Gravenhurst Banner* about a Sharp-tailed Grouse killed near Beaumaris in October 1896, the first reported capture of this species east of Sault Ste. Marie.[9]

Not all the activity and conversation in Spanner's shop was centred on birds. Spanner designed, built and raced his own boats almost weekly throughout the season. At times the conversations centred on yachts and yachting, on technicalities such as load waterlines, beam, sail areas and length overall. Taverner often crewed for Spanner in his 19 foot class boat.[10] It was good fun and many years later he still hankered after "the feel of the stick and the pull of the sheet".[11] During the years 1897 and 1898 Taverner was often in Spanner's shop as birds were brought in to be "made up" for collectors. He had the opportunity to see birds in various plumages — spring breeding, fall molt and winter plumage, as

The taxidermy shop of Oliver Spanner and Company at 358 Yonge Street, Toronto, which Taverner frequented to obtain the latest bird sightings. Galbraith Photo, Toronto, Ontario, undated, but wall calendar reads 1902. (Reproduced courtesy of the Royal Ontario Museum Library and Archives, number 0001264.)

well as the chance to study their anatomy closely,[12] such as the male Cory's Least Bittern Spanner obtained. In his notebook Taverner recorded some bird outings in the spring in Toronto with Fleming, or with Lambe, or others. Once Spanner and Taverner cycled out to the western suburb of Etobicoke in early April where they got two Ruby-crowned Kinglets and an Eastern Phoebe. In May 1897 he was at Muskoka recording the spring migration. That summer he was in his boat near Crown Island when he saw two large hawks with pointed wings fly round him screeching loudly. He guessed they were Duck Hawks [Peregrine Falcons] and that the white on the cliffs marked the site of a nest. He decided that if he could screw his courage up to the point he would have himself lowered to where he could look at the cliff face. Later he heard that two local boys had climbed down and taken the eggs. However, in 1898 he found another Peregrine's nest off Crown Island that it was possible to look into. When a clutch of four eggs was in the nest he took a photograph of them. In 1897 his mother and sister were not listed in the guest book as being at the cottage, but a family of ten from Pittsburgh rented it from early July until mid-September. Percy then moved into the cottage and left on 23 December. It must have been a cold stay all alone on Gibraltar Island, one that Percy remembered all his life, and the story of how he managed to fend for himself was one that was handed down orally, and probably gained in the telling.[13] Back in Toronto in time for Christmas he caught up on the bird news from Fleming and Spanner.

The following spring (1898) Percy went to the cottage again though according to the log-book his mother and sister were not present at any time. Much of the summer he spent doing photographic work among the tourists. Percy kept a notebook in which he recorded his negatives numbered from one to 148, with a short title for each subject. At the back of the book was a list of photos giving date, size, type of paper and mounts, and a number as though prints had been sold. There were some pictures of the Muskoka area though more were of Ann Arbor.[14] He must have been busy with photography and taxidermy jobs because his bird notes were very scanty

and then petered out altogether. Early in December he was sent a [Northern] Hawk Owl for mounting by a friend in Beaumaris which had been shot by two of his boys. They had seen it perched on a tree as they walked to school. When they returned it was still there so they went home, fetched a gun, went back and shot it. Taverner commented with his tongue in his cheek: "A truly unsophisticated bird." Percy returned to Toronto a few days before Christmas in time to spend Christmas with his mother and sister Ida in Port Huron.[15]

The year 1899 marks a major change in Taverner's life. This was the year in which he kept no bird notes, not even a spring migration list, but settled down to learn a profession on which he could depend for a living. He boarded with the family of C. F. Smith at 513 St. Clair Street, Port Huron, where he had previously lived while at Junior school. It was like coming home. Percy had already shown an ability to draw quite well and now he was to put this promise to the test. He took a correspondence course in architecture while working in the office of George L. Harvey, architect, for the sum of $3.00 a week.[16] In the spring, summer and fall he went out early in the morning bird watching, spent working hours in his employer's office tracing plans and drafting buildings, and at night supplemented his tiny salary by rowing passengers across the St. Clair River to Sarnia after the regular ferry had stopped. The fare was 25 cents, and drunks who had missed the ferry boat were regular customers. Percy kept a cudgel in his boat for self defence if necessary. Potentially more dangerous were the numerous freighters between which Percy had to steer a course.[17] He also took on odd jobs of commercial and private taxidermy. In his photographic notebook, dated 1899, he copied out four pages of notes from Rowley's "Art of Taxidermy" which were mainly of chemical formulae. In spite of starting to study for a career Percy did not give up practising taxidermy, as witness a letter he wrote to Ernest Seton-Thompson early in 1900 about the possibility of taxidermy being raised to the position of a high art. At this time Thompson-Seton (the form of his name which he used from 1902 onwards) was known as a wildlife artist, though his book, *Wild Animals I Have Known*, published in 1898, was to make him better known as a naturalist writer. Seton answered that "the taxidermist must learn form and expression, just as the sculptor or painter does. As a matter of fact he must be a sculptor... The best art is always suggestive not realistic ... Its strongest quality then, is to appeal to the imagination." He ended by stating his opinion that taxidermy could never rank among the higher arts.[18] Percy continued taxidermy work, not as an art but as a means of barter. The following advertisement appeared in the magazine *American Ornithology* at this time. "Old Magazines Wanted — I will be prepared this spring [1901] to exchange mounted birds and scientific skins from this locality for back numbers of magazines. Address: P. A. Taverner, Port Huron, Mich."[19]

Another step which Taverner took at this time was to write to John Macoun, Naturalist, The Geological Survey of Canada, with several records of birds taken in the Muskoka area. These were intended for incorporation in the *Catalogue of Canadian Birds* which Macoun was in the process of compiling.[20] Taverner wrote to him in December 1899 with information on the Sharp-tailed Grouse movement and mentioned a Wilson's Petrel [Wilson's Storm Petrel]. Macoun replied asking Taverner to write a note on the petrel and send any notes that he had on geographical distribution that would add to the information in Thomas McIlwraith's *Birds of Ontario,* as well as notes on nesting habits of birds and the construction of their nests.[21] This was an important step forward for Taverner's recognition in ornithological circles. John Macoun, although primarily a botanist, was the senior government naturalist in Canada at this time, and as such was responsible for compiling the first comprehensive annotated list of birds recorded in Canada. Taverner was an unknown enthusiast who had already collected a few relatively rare species and was keeping detailed records in the Muskoka area. He realized the value of being in touch with a man of John Macoun's prestige and having his records accepted in such an important compilation. One further development in Taverner's efforts to be accepted as a reliable amateur ornithologist was his election to associate membership in the American Ornithologists' Union.[22]

As regards his family life in Port Huron not much is known. The 1900 United States Population Census shows that there were six people living at 513 St. Clair Street: Charles Smith, his wife Maria, his son John, his grandson Stanley and granddaughter Gale, and Percy Tavernier. Percy was shown as being born in Canada, his parents as both born in England. The year of his immigration into the States was shown as 1885, his profession as architect, and his marital status as single.[23] John Smith is shown as "widdower", his profession as travelling salesman. Charles Smith was born in New York; Maria Smith was born in Canada, her father was born in England and her mother in Ireland. Mr. Smith's occupation was given as "Superintendent of street sprinklers". Percy's sister described his continuing interest in natural history at this time.

> "His room in Port Huron was a veritable magnet for congenial spirits... The trays of eggs and artificial birds' eyes were fascinating to me, and all his explanations of birds and animals, in fact everything. He always seemed an encyclopedia. In fact he was a great reader of that very work and often had three or four volumes ... under his bed."[24]

Percy's mother had left the stage at the end of the 1897 season as far as we know. She herself said that

when she found a demand for other work that she could do she "quietly left the field to those who had the power to amuse and attract by newer methods".[25] Percy described her new vocation as "organizational work for a fraternal insurance company".[26] From several sheets of headed notepaper that Percy used in 1904 we know that Ida Van Cortland was employed by the Independent Order of Foresters.[27] This is not quite such a dramatic change of occupation as may seem on the surface. Ida's experience organizing the Tavernier Company and travelling on circuit through Michigan and Illinois would have given her the ability to organize salesmen selling insurance for the Foresters. We know that by 1902 Ida Van Cortland was in Chicago in this capacity. Whether she was already working for the Foresters while living in Port Hurton is not known.[28]

Information gleaned from the cottage log-book is of interest for this period. In 1899 it shows Ida Van Cortland and Ida Clare spending the summer at the cottage on Point Coo-ee with eleven visitors altogether, including a Mrs. Ella T. Nash who came to Muskoka as a representative of *Campbells Illustrated Journal*. She hoped to have an article on the Muskoka Lakes in its October 1899 issue commissioned by the Grand Trunk Rail Road and Navigation Co. She planned to use the material gathered during the summer for descriptive articles for various magazines in the spring of 1900, together with illustrations supplied by the G.T.R. One evening in August 1899 she gave a talk to a large audience at the Prowses' hotel at Beaumaris on "palmistry", and for several days subsequently she was kept busy reading hands. Percy was not listed as visiting but Stanley Smith, aged ten, was there. For the years 1901-1903 the cottage at Point Coo-ee was rented out, while the Taverner family used the shanty at Kamp Kozy Korner. In 1901 the family occupied the same place during August and Percy expended a lot of energy trying to destroy poison ivy which had taken over the Point where they hoped to build a new cottage.

At some time between 1901 and early 1902 Percy's mother and sister moved to Chicago where Ida worked in the central office of the Independent Order of Foresters. Percy was still in Port Huron in August 1901[29], but during the winter of 1901-1902 he took a night course in Chicago[30], and during the spring of 1902 he was keeping an active bird migration list there.[31] All Percy himself said about his stay in Chicago was that he was a draftsman in various architectural offices, but spent much spare time bird watching with opera glasses in the city parks, as well as some minor collecting, mainly about Roby Lake on the outskirts of the city.[32] However, his sister was more forthcoming and wrote:

> "In Chicago Percy had a very severe pneumonia, nearly didn't make it. It was then he grew a beard; the Doctor thought he had better not remove it during the winter and he wore it always thereafter".[33]

Most likely this was during the winter of 1902-1903 because he wrote at the beginning of May 1903 of "my late sickness" as if it had occurred then.[34] Certainly by early March he was out watching birds with a companion and explaining in his ornithological notes how and where they went as though he was seeing some of these streets for the first time. The disjointed and simple notes in which he had recorded what he had seen in the period 1893-1898 now, after a lapse of four years, suddenly blossomed again. But the style had been transformed in the intervening years; the brash young naturalist had matured. He was now more than a collector of bird skins, he was also a collector of precious moments and impressions inspired by the songs and movements of birds in their natural surroundings. He compared the fresh looking plumage of what he considered to be newly arrived Song Sparrows on migration with the plumage of Horned Larks, grimy from the city's smoke by which he judged that they had spent the winter in Chicago.[35] Walking in Jackson Park one April morning he saw a male White-throated Sparrow, and heard a single whistle come through the fog from across the lagoon. "His 'hard times Canada, Canada, Canada' went right to my heart. It is the first I have heard since leaving Muskoka and his clear whistle brought back memories of gorgeous sunsets through black pines upon placid lake and for a moment all the glamour of the northern wilds was about me."[36] Percy no longer wrote for utilitarian reasons only; he wrote to communicate his feelings and his appreciation of nature to others. His notes now can be classed as a journal.

An exciting few days occurred at the beginning of May 1903 when his friend Fleming came to Chicago to join an AOU excursion to California. Fleming stayed at the Taverners' so that the two men had plenty of opportunity to talk about ornithology. The first night they sat up and talked birds and other things until 2 a.m. The next morning they went to see Professor Whitman, well known as a pigeon fancier, who had species from all over the world in his aviaries — Band-tailed from Western North America; Ringed-neck Turtle Doves [Ring-necked Doves]; ground doves from Australia, New Zealand and South America; Malacca Pigeons; Blue Rocks [Rock Doves] from Europe and many others whose names Taverner promptly forgot. But to Taverner the gems of the Professor's collection were twelve Passenger Pigeons.

> "This day I have seen real live Passenger Pigeons. Think of it. I am almost humbled with my good fortune. And grand birds they are. These seemed as strong and lively as though they were not about the last of their race but as they were when their numbers filled the heavens and their shadow blotted out the landscape from sight."[37]

In the afternoon Fleming and Taverner went to the Field Museum and were full of admiration for the

taxidermy work of the Virginia deer and Quagga groups. When the museum closed at 4 p.m. they walked home through the shrubbery on one side of Wooded Island and noted Palm and Myrtle [Yellow-rumped] Warblers, White-throated Sparrows and Blue-gray Gnatcatchers as common, and one Scarlet Tanager. In the lagoon were [Common] Loon, Horned Grebe, and Blue-bill [scaup] and Red-breasted Mergansers.[38] On the way Percy and Fleming had a talk about Ernest Thompson Seton. They both agreed that from what they read it seemed that Seton had passed his zenith and that his current serial in the *Ladies Home Journal* was a failure. In the evening Percy went with Fleming to the home of Ruthven Deane where they met some of the bright lights of the bird world — T. S. Palmer, Frank Chapman, J. A. Allen and C. H. Merriam, to name only a few.[39] Percy wrote that he was so bewildered by the presence of the great ones that he could hardly remember who was there and who was not. This was the first time that he had seen any famous ornithologists, and he was somewhat overawed, but at the same time reassured to see that they walked and talked like ordinary mortals. He went with them to the depot to see them board their private excursion train. When the train arrived the gates were opened and they all filed through except the odd man out — Percy Taverner. It was a poignant moment which he described with feeling in his journal. As he watched them climb into the Pullman coaches he knew that they were bound on the most delightful excursion that America could offer to a man of his interests. It tasted a little bitter to realize that the money spent during his "late sickness" would have carried him with them and back again and satisfied one of the strongest desires of his life.[40] He felt a little "sad for himself" by the tone of his entry. Although by now they would have forgotten him and his almost unpronounceable name, yet the memory of having met them would urge him on to work, and one day, if he lived, he would join an AOU trip himself.

Taverner was not "down in the dumps" for long. In June he went to Roby Lake and recorded that King Rails were "common". He found the nest of one with a young bird just coming out of the shell, a little black ball with shiny black eyes. The parent bird came off the nest at Percy's feet with an amazing splashing and cackling. Later Taverner went back to the nest and had a good look at the bird and identified it with certainty. He counted the remains of twelve eggs. With a companion he found several small rails' nests but all had hatched and the young gone. Later they found a nest with one Least Bittern's egg, as well as flushing five or six of this species. His comment in his notes was enthusiastic: "This has been a day indeed — a day to remember."[41] During the heat of late summer he did little collecting in the field. Instead he made use of the Field Columbian Museum for learning more about ornithology. One day he visited Professor Dearborn who described the method developed by the taxidermist Akerley for making models in clay and papier mache, and coated with shellac, which were both strong and relatively light. This information was to be useful to Taverner several years later.[42]

His ornithological education was also broadened by his correspondence with Fleming, giving perspectives on a wider world. The group of 40 members of the AOU under their leader, C. Hart Merriam, whom he saw off at the depot in May in two special Pullman cars visited Santa Fe, the Grand Canyon, the Mojave Desert, San Bernardino and Los Angeles before attending the AOU meeting at San Francisco.[43] Fleming wrote to Percy with his personal impressions of some of the participants.

> "Dr. Merriam is simply a wonderful man full of information, and the success of the trip is mostly due to him. Chapman was not visible in the smoking room after. He has a wife big enough to squash him a huge woman, he also has his mother with him. I liked Dr. Allen he was very quiet and nice. He smokes when permitted. Mrs. Allen was very nice but she kept a close eye on him. I got to like her. The real revelation of the trip was Fuertes the artist as modest unassuming a fellow as one would want to meet he is a genius. I don't like all his work but it is based on a thorough knowledge. He has a big future before him."[44]

Such a letter would serve to make Percy feel as though he might be able to get to know these distinguished men one day, that they were quite human. It may also have made him determined to earn their approval so that eventually when he attended an AOU meeting they would know who he was. Judging from a few remarks in his journal entries he was suffering from a sense of inferiority perhaps caused by his stammer and, in addition, by a lack of self confidence resulting from an insecurity of identity. He had not yet made his mark.

In October 1903 he attended a lecture at the Field Museum on bird migration which was illustrated with slides, and with maps showing breeding, transient and winter quarters of various birds. One that impressed Taverner was the Black-bellied Plover which, in the American continent, was capable of migrating from its arctic breeding grounds south as far as Patagonia. This excited Percy's imagination and set his mind working. In his journal he recorded that after coming home he started to ponder the problem of migration, and asked himself the question "why do these birds travel this awful distance?" He argued that it cannot be lack of food in their southern grounds because they support themselves all winter there and surely must be able to do the same during the summer. He then sketched out a theory to explain this in his journal, using notes he had made from books and articles on natural history problems such as the migration of birds.[45] He impulsively sent his first thoughts on the cause and origin

of migration to Fleming for criticism.[46] Fleming showed them to Dr. Brodie who said that Taverner was rather mixed up over the extent of the Ice Age, and Fleming advised him to read some modern European writings on the subject before offering them as a paper. He encouraged Taverner to keep thinking. "Go ahead and think all you can. You are able to transfer your thoughts to paper, a blessing few possess." Taverner went ahead, but instead wrote to J. A. Allen who advised him to send his paper to the AOU Secretary before 13 November of that year. [47] It was accepted as a short paper for the Twenty First AOU Meeting in Philadelphia. Since Percy did not attend the meeting his contribution was given to Dr. T. S. Palmer, Assistant in Charge of Game Preservation, the US Biological Survey, who read it aloud on his behalf. This was a typical action by Taverner as a younger man. He acted impetuously rather than cool-headedly. However, the AOU members listening to it received it well and, according to Fleming's report they applauded. There was only one comment, namely that A. R. Wallace, the independent discoverer of the concept of evolution, had referred to a somewhat similar theory in his *Geographical Distribution of Animals*.[48] But this was only the beginning. Taverner now wanted to have it published in *The Auk* but to do that Allen, the editor, said that a number of basic changes would have to be made. T. S. Palmer wrote suggesting that he should read a chapter by Professor W. K. Brooks on "Migration in its Bearing on Lamarckism".[49] In reply to a further query from Taverner about the possibility of publishing it in *The Auk*, Allen jumped on him saying that it was not a new hypothesis; that he himself had put forward the same ideas as hypotheses ten years ago; that Taverner's statement that no glacial traces had as yet been discovered in the southern hemisphere were "grossly in error".[50] In a second letter he advised Taverner to revise his paper and to discriminate clearly between what he considered to be new ideas and what was common property.[51] Finally he wrote saying that the revisions were satisfactory and it was now all right for publication in *The Auk*.[52] It was published as an eleven page article in *The Auk* with the title "A Discussion of the Origin of Migration". In it he discussed several different hypotheses, among which was that of Alfred Russell Wallace who suggested that migrants in the spring were searching for soft-bodied insects suitable for nestlings; that as the season advances in the tropics it becomes dryer and dryer and such insects soon disappear. Taverner speculated that it was the need for large quantities of food that drove them north. As an article summarizing the various views of that time it was found to be useful. It was a useful exercise in hypotheses.[53]

Towards the end of 1903 Taverner's creative energy suddenly began to blossom and his physical energy to match the workings of his mind. In his "Journal of Bird Observations" for 28 November 1903 he noted that he had written to Dr. Palmer thanking him for reading his paper and for his criticism. He took the opportunity to mention his own scheme for studying the migrations of individual birds by tagging (banding) them, and asked Palmer if he thought that a general movement for tagging migrants by an organized scheme could be started. This was fortunate timing. Palmer replied that Dr. Paul Bartsch of the Smithsonian had made some experiments in tagging 100 night herons in two colonies near Washington, and had a paper in the press discussing the results. Palmer also showed Taverner's letter to Professor Wells Cooke of the Game Preservation Department, who was in charge of bird migration and distribution data. He suggested that Taverner should write to both men outlining his scheme. Taverner proposed that the Migration Committee of the Biological Survey should issue small rings made of aluminum wire or some light non-corrosive metal. The rings should be stamped with a number and a record kept of those to whom they were sent.[54]

In a letter to Fleming he said that the whole body of ornithologists would have to participate in order to get any results. He also mentioned that he had designed a brick trap for capturing ground-feeding birds. In his Journal he drew a draftsman's plan of perspective views of the trap with measurements.[55] In the same letter he said he was undergoing an extensive course of reading in order to get his ideas together and to satisfy himself. He mentioned that he was thinking about the property of matter, the unity of nature, the tendency to bring in electricity to explain anything complicated. He was sending Fleming a separate paper on evolution.[56] Fleming seemed to be acting as his "supervisor of studies" to whom he submitted essays for criticism — and encouragement. Taverner had a lot of productive energy at this time because he had a good deal of spare time. In fact he mentioned being laid off work during the past winter.[57] So he started a number of projects, one of which was to make sketches for an extension to Fleming's house for a bird room which he sent him for comments and return.[58] He also found time to write a short paper on feathers and sent it to the acknowledged expert on the subject, Dr. Jonathan Dwight. This was typical of Taverner at this period in his life. He would get enthusiastic about a problem, read it up as best he could, study it in the field if possible or in a museum, and then produce something on paper which could hardly fail to be superficial. But nevertheless he sent it off to an expert to read. Dwight treated him kindly in his reply, told him where he was wrong but gave him encouragement when he praised him for being "so close an observer".[59]

By the beginning of 1904 he knew that his mother was to be transferred to Detroit in the spring by the Independent Order of Foresters. He told Fleming the news and commented that they hoped to buy a place in the suburbs and settle there for good since his mother "had been given complete charge of the state'. Percy welcomed the prospect of moving to Detroit and wrote:

> "Detroit will make a good centre for bird work it is easy to reach Port Huron and the transitional fauna and also Ann Arbor and the Carolinian ... I believe the Mich[igan] Ornith.[ological] Club is also progressive and has its headquarters in Detroit. Altogether I am looking forward to the change with a great deal of pleasure. Another great improvement will be in being nearer to Muskoka."[60]

There was exciting news from the University of Michigan museum at Ann Arbor. When Percy knew that he would be living in Detroit he wrote to his friend Norman Wood the taxidermist there. Wood was glad to hear the news and sent Percy a Museum Report and a copy of the Michigan Ornithological Club Bulletin. The main bird news was that in June 1903 Wood had spent nearly three weeks in the south of Michigan and had found three colonies of breeding Kirtland's Warblers. He had the only photos of this rare warbler to be taken from life in various postures. He promised Percy a copy of his account of this discovery and asked for a copy of Percy's article on the origins of migration.[61]

The Taverner family had lived in Chicago for only three years, not sufficient time to put down roots and make a circle of friends. Their memories of those years were likely to have been clouded by Percy's nearly fatal illness. Chicago, in the first decade of the twentieth century, was a booming city of industries, railways, dockyards and immigrants packed into suburbs. It was also a financial centre of expanding wealth and population, new architectural styles, and labour unrest. It was a city in which the air was regularly polluted; it was not the best place for someone whose lungs had recently been weakened by pneumonia.[62]

# Part II — Apprenticeship Years

## CHAPTER 4. Ornithologist-in-the-Making

The move from Chicago to Detroit was yet another upheaval for Percy, his mother and sister; they had already done enough moving for a normal life-time. But there is little indication that they regarded Chicago as a permanent home, and if they were merely exchanging one large American city for another fast-growing modern one they were, at least, returning to an area that they were more familiar with — southeastern Michigan. Detroit was no distance by interurban rail from Ann Arbor and Port Huron where they had good friends, places where Percy had lived and would feel at home. For Percy Detroit had the advantage of being nearer to Toronto and the opportunity of seeing his good friend Fleming from time to time.

They arrived in Detroit at a good time of the year — early spring, and Percy soon began to explore the neighbourhood for birding spots. In his journal for 6 April 1904 he listed sixteen species seen, among which were [Eastern] Bluebird, [Rufous-sided] Towhee, [Eastern] Meadowlark, Vesper Sparrow, Fox Sparrow, and Purple Finch.[1] He was off to a good start, exploring a new location in the spring of the year, doing what he enjoyed most and transforming his observations into notes for his journal. It did not take him long to renew old friendships and make new ones through the Michigan Ornithological Club (MOC), of which he had previously been a member. He attended the annual meeting of the club at Ann Arbor early in April when he heard two papers on the Kirtland's Warbler.[2] Wood asked him to come and look for Kirtland's Warblers but he reluctantly had to refuse. As he explained to Fleming:

> "What with my lay off last winter and the expences and enforced idleness consequent on our moving I'm afraid my bank ac't [account] will not permit it. Too bad to lose such a chance too, isn't it."[3]

This was not the first time, and it wasn't to be the last, when Percy lost an excellent birding opportunity owing to lack of money. However, the rare Kirtland's Warbler gave him an interesting topic to investigate and a problem on which to write a short article. His paper "The Origin of Migration" was published in *The Auk* in 1904[4] and this slight success in the field of speculation probably encouraged him to focus on the origin of the Kirtland's Warbler. Based on information in the two talks he had heard, he speculated on how the Kirtland's could have originated. He came to the conclusion that from present knowledge it seemed likely that

> "Kirtland's Warbler is what remains of a once far more widely distributed species wintering along the Gulf States and spread from thence to the Bahama Islands. They migrated up the Mississipi Valley and perhaps also up the Eastern States, which would account for our records at Washington and elsewhere along that line. The breeding grounds then likely covered the greater part of the Alleghanian Transition Zone. Changed conditions rendered this continental portion of the southern habitat untenable for a permanent winter residence, and the species became extinct there, leaving the Bahaman individuals the only surviving representatives of the race."

Taverner offered no suggestion as to what the "changed conditions" were.[5]

By publishing papers and taking an active part in an ornithological club Taverner became known as a serious amateur ornithologist studying the birds of the Michigan-Ontario border. In this way he was able to hold up his head and not let his stammer, lack of higher education, and money weigh on him too heavily. By nature he was resilient and quick to enjoy life in the company of congenial friends, especially if this meant field trips or just short tramps in the country observing and recording the natural world. Through the MOC he quickly made a friend with whom he was to spend a great deal of time in the next few years. Bradshaw H. Swales was born in Detroit in June 1875, the same month and year as Taverner. He graduated from the University of Michigan with a degree in law, and by the time they met in April 1904 had already published some forty bird notes in various journals, based on his knowledge of Michigan birds. He was also making a collection of skins. Both men had a strong attachment to "scientific" ornithology as opposed to egg collecting and casual list making and they soon teamed up. Through Swales, Percy met Walter Barrows, Professor of Zoology at Michigan Agricultural College, East Lansing, a recognized ornithologist, with whom he had recently corresponded about the [Northern] Wheatear record claimed by Covert. They first met at Swales' house where they talked birds until after midnight, mainly about Barrows' projected List of Birds of Michigan.[6] Barrows wanted the notes that Swales and Taverner were collecting on the birds of St. Clair County. This was a fruitful meeting for Percy since Barrows became another professional ornithologist friend with whom he corresponded regularly, and from whom he could learn much. He was also a useful "patron" for Percy's drawings.

From the beginning of May until mid-July 1904 Swales and Taverner birded whenever they were free, and Taverner's journal contains regular descriptions, some quite extensive, written with verve and sharp images. Taverner was enjoying the spring weather and the new countryside, and his pleasure is reflected in his writing. They were birding on 4 May and Taverner noted that the big migration day nearly always occurred around that time. To him 4 May was the greatest day of the whole year. He described seeing his first hummingbird of the year and concluded "Well this great day has come and gone."[7] There was a new zest and feeling of satisfaction about what he saw and heard. He could hardly wait to get away from work as his entry for 7 May shows: "Saturday is my afternoon off — off to the woods." With two new acquaintances he went to Gross Point where he noted: "Birds, birds everywhere and all singing". By 21 May he noted that the spring migration seemed almost over. But Swales and Taverner continued to go out regularly, as breeding birds were active. On 30 May they found two nests of Louisiana Waterthrushes and put bands on seven young birds about to leave the nest.[8] Early in June they made the first of many visits to the St. Clair mud flats where they began a new project of record keeping. They travelled on the Port Huron Rapid Railway System to Pearl Beach and stayed the night at the Wellington. They spent considerable time on the St. Clair flats in the next few years obtaining valuable information for Barrows' Michigan list.

Apart from Swales, Percy's first impressions of some of the other members of the MOC were not encouraging. In mid-April they went birding with J. Clair [Clare] Wood and two others along the Ann Arbor-Ypsilanti Electric Railroad. The others had some hawk nests marked and soon had taken three sets of Red-shouldered Hawks' eggs.

Meanwhile Taverner and Swales sat and watched a Turkey Vulture sailing about through their glasses, the first he had seen since his early days at Ann Arbor. Taverner gave his impressions of the others in his journal:

> "First impressions are hardly to be trusted but I am afraid that the ornithologists of Detroit are mostly "collectors" and egg collectors at that. Clair Wood seems to have had the most experience of any of them but he makes but small pretentions towards science, and I believe that he is apt to jump to conclusions. He keeps no notes and has faith in his memory — a great fault with a naturalist. Swales seems to be the only one here with any appreciation of the meaning of scientific work and he bewailed the inaccuracies that have unavoidably crept into the records from the above causes. He cited two cases of Yellow Chat [Yellow-breasted Chat] breeding records here in Wayne [County] but in neither case were the parent birds seen. Identification was solely from nest and eggs."[9]

Taverner reveals as much about himself as the others. His ambition was to study birds in all their aspects, their relationship to each other and to their habitat, and to study this scientifically, taking nothing for granted. It was a justified avocation and in trying to live up to it he got a great deal of quiet satisfaction. The others behaved like boys, and his journal shows them doing it.

> "As the rest of the party rushed off from one hawk tree to another and intent only apparently of [on] gathering a lot of eggs Swales & I found the pace too fast for any observations so we dropped behind and proceeded to "naturalize" according to our own ideals which was [sic] in this case to sit on a rail fence in the warm sun and discuss ornithology in general and listened [sic] to the Winter Wren as he tried to recall his old breeding song or watched the grand majestic flight of our only Vulture — the Turkey Buzzard [Turkey Vulture]. We gained notes on two species. Wood, Wisner & Wood got several egg shells. Who gained the most [?]."[10]

Taverner was ready for his annual holiday in Muskoka in late August, but compared with some

other years when he was there in spring and summer there were few birds to be seen. Leaving Beaumaris early in September he joined Fleming in Toronto, and the following day they went to visit Klugh at his cottage.[11] The next day Taverner continued to London and spent the afternoon with Saunders looking at his bird skins, and taking notes from his List of Birds of Western Ontario.[12]

There are some indications at this time that Percy was bored with being a draftsman. On the other hand when Fleming wanted plans for an extension to his house in Toronto Taverner set to with enthusiasm. Again, when Fleming needed maps made with data on them about irruptions of Brunnich's Murre [Thick-billed Murre], for making slides which he could take with him when he attended the Fourth International Ornithological Congress in England in June 1905, Taverner was willing enough to make them. "Do not hesitate to send your map data to me. It is really a comparatively short job to make the maps. I will trace them off and mark them up in pretty short order. Of course I am pretty busy but I never found my time so well occupied but that I could not get in a little more work."[13] This might be the motto for the whole of the rest of Taverner's life; he was well on the way to becoming a compulsive work horse.

Family life seems to have settled down well for all three Taverners in Detroit. His half-sister, now a woman of twenty, took piano lessons from a Miss Martha Hohly of the Michigan Conservatory of Music. Martha was born in Toledo in 1880 and came to Detroit in 1900 where she taught piano and also acted as accompanist at concerts. In December 1906 she was invited to accompany the French violinist Henri Ern who was sharing a concert at which the French composer Camille Saint-Saens was the piano soloist, and the program was mainly of his compositions. Thus Martha played the accompaniment to Saint-Saens' well known Introduction and Rondo Capriccioso with the maestro nearby.[14] Ida would have known about the concert and very likely would have attended it with her family, especially since in 1907 she was offering piano lessons herself.[15] Cultural life in Detroit during the first decade of the twentieth century was flourishing. There were plays, operas, concerts of various kinds, recitals, vaudeville entertainment as well as amateur performances taking place regularly. A look at the entertainment pages of the *Detroit News Tribune* for a single month in 1908 will give an idea of the diversity of entertainment available to the people of Detroit. As an acting family the Taverners would have been interested to see some of the plays and operas, and some of the "stars" who performed in them. Letters between Fleming and Taverner were not entirely about birds, and Fleming reported from Toronto:

> "Saw Ben Greet's Company in Julius Caesar yesterday, most interesting; the plays are produced as they were in Shakespeare's time. I saw him at the University a year or so ago playing in the open air. One gets a much better idea of Shakespeare when the scenic effects are not present to distract the attention."[16]

At the end of this letter Fleming's strong sense of humour shines through. He wanted to let his friend know that he was forgetful about signing his letters.

> "P.S. Please sign your letters. You may put W.P. (without prejudice) if you like as the lawyers do, and feel yourself safe."

Though life was by no means perfect it was reasonably good. They had friends, such as the Smith family in Port Huron, with whom they spent Christmas Day 1905. Other friends, such as W. E. Saunders and family, encouraged the Taverners' fondness for music. The Saunders stayed with the Taverners when they went to Detroit to hear the Boston Symphony Orchestra, and Ida and the Saunders' daughter got acquainted.[17]

A major event for the Taverners occurred in 1907 when Martha Hohly married Jacob Merton Wiest, the Sunday editor of the *Detroit News Tribune*. His photograph shows him to be a handsome young man. He had a good voice and was a soloist of some repute locally. The Wiests and the Taverners became friends and used to take part in amateur musical/operatic concerts. They formed a strong team. Ida Van Cortland had plenty of experience in acting and could help in the production of amateur performances. Martha could play anything required on the piano, Jacob Wiest had natural acting ability as well as a good voice, Percy was a useful handyman in stage design and lighting and Ida C. could act and help wherever needed.[18]

But for Percy ornithology took first place and absorbed most of his surplus time and energy. The journal which he kept regularly during these years at Detroit contained a number of quite long entries. Above all he seems to have derived so much intense pleasure from his birding rambles that he wanted to preserve them permanently as happy memories. Sometimes Percy designated a certain date as a red-letter day. For instance the entry for 2 October 1904:

> "This has been a *day*. A sparrow day and a day above all other days. This should all be written in red ink."[19]

Then for the next seven pages he related what he had seen as though he was compelled to tell it in full even if no one was likely to read it. Another of these special days occurred on 5 August 1905.

> "A Red Letter day to an ornithologist is one in which he discovers something new — at least to him — within the way of habit of some before known species or a new species altogether. Today I did the latter."[20]

Such days were recorded red-hot as the words tumbled into his mind and the excitement of what he had seen moved him. Sometimes, when he had been for a "tramp of exploration" he included a small sketch map neatly drawn. In the spring he usually included a list of the first wild flowers seen during his April walks, before being overwhelmed by the

full warbler migration in May. Another entry might convey something of the tension that built up inside him when he had spent all day in the office bent over his drawing board drafting plans while outside the birds were away and flying. He was like a coiled spring until, suddenly, it was time to go and he made a dash for it.

> "This evening took a hurry-up jaunt to the country and back by way of Palmer Park woods. Left the office at 5:30 and took the car right out there. It is not dark until about seven o'clock now and I had an hour or so of daylight before me."[21]

Apart from his constant companion — his journal — there was a regular flow of letters between Fleming and himself which continued until Fleming's death in 1940. After he reached Detroit his letters to Fleming began to mature, perhaps because he was stimulated by the new areas he was discovering, the rarer birds seen and new people he met. Many of these letters had an urgency about them, a sense of excitement that complemented Fleming's cautious approach. It is true that at the same time he was writing regularly to others such as Professor Barrows and Norman Wood, to mention only a few, but these were run-of-the-mill ornithological letters, while letters to Fleming, and from Fleming, were special. They were always about bird matters in some form or other, but often contained bits of information on their families, friends, gardens, health and personal opinions. Taverner, like Fleming, had a light touch, a gleam of humour that was part of his style. He first started typing letters to Fleming in late 1905 when he said at the end of a letter: "My handwriting is slowly improving but this machine cannot spell correctly."[22] Taverner's erratic spelling was something no typewriter could cure. However, his practical mind was pleased with the information that the signs for sex, a useful thing for ornithologists, could be put on a new machine free of charge. He also began to use a typewriter to copy out his rough bird notes which would have the double advantage of being easier for him to keep and easy for others to read. It also meant that he had a carbon copy for other use.

Apart from the information Taverner gained through his correspondence with Fleming and other amateur ornithologists, and through letters and conversation with professional museum men, he had also begun to educate himself in the principles and practice of ornithology through reading. Although he could not afford to buy a collection of books and journals, nevertheless he borrowed from Fleming and scanned trade catalogues for bargains he could afford. His first major step in self education was to read Elliot Coues' treatise *Key to North American Birds*, designed as a manual of North American ornithology which would enable the reader to identify and label the specimens he obtained. The first section was devoted to "field ornithology", that is: how to collect and preserve bird specimens for study. Coues explained the rationale of field ornithology.

> "The true ornithologist goes out to study birds alive and destroys some simply because that is the only way of learning their structure and technical characters".

The reader is admonished to "shoot an unknown bird on sight..." and to collect skins as duplicates since they can be used as a medium of exchange. The best way to determine the exact geographical distribution of a species is "to have specimens from as many different and widely separated localities as possible", as even the commonest bird has a special value if collected outside its normal range.

> "But let all your justifiable destruction of birds be tempered with mercy; your humanity ... should never permit you to take life wantonly."[23]

Another book which he relied on in this period and which influenced him was Robert Ridgway's first volumes of *The Birds of North and Middle America*. In this period he was continually reading articles and notes as they appeared in *The Auk*, the most widely read of the ornithological journals at that time. As a member of the AOU he would have received a quarterly copy since early 1903. At the same time he bought "back numbers" whenever he could find them.

Another advance that Percy made while in Detroit was in the technical side of his "calling", namely the equipment he used and his skill in using it. As a boy, and even later, he had to make do with opera glasses instead of field glasses because of the cost. But once settled in a steady job in Detroit he felt the need of adequate equipment. On the red-letter "sparrow day" in October 1904 he noted in his journal that opera glasses failed to bring out the colour of birds well on cloudy days. As a result he wrote to a friend at the cottage-colony at Lake Muskoka, John Brashear, enquiring about the cost of field glasses. Since his friend was a partner in the firm of John A. Brashear Co. Ltd. of Allegheny, Pa., makers of astronomical and physical instruments, he did not lack for good advice. The best quality would cost about $48 a pair, but for about $10 it was possible to buy an adequate pair with good lighting.[24] The next advance in equipment came in June 1909 when Fleming asked him, in a letter, what field glasses he was using. Although gaps in the correspondence exist we know that Fleming had recently invested in a pair of binoculars and wanted Percy also to benefit from having a pair.

Flemming wrote:

> "Ever since I got those prism binoculars, I have seen the advisability of your having a pair, and if you will put that $35.00 in the savings bank I think I can fix you out with a pair, that is if you are not too particular as to make or above a gift from an old friend. I have recently got a pair of less power as I felt it was unwise for me to use glasses of too high a power as my eyes are not too strong. In fact I should not use glasses of any kind."[25]

But aspiring to be a scientific ornithologist with only a pair of glasses and no gun was impractical and Percy was never without a gun if he could help it. At this point in his career he owned a .410 — a small shotgun with short barrel, light and handy for carrying, and ideal for collecting small birds. For larger birds he invested in a double-barrelled twelve gauge hammerless shotgun.[26] Since nearly all Taverner's ornithological friends and acquaintances collected birds he was able to get practical advice when he wanted it. W. E. Clyde Todd, of the Carnegie Museum, Pittsburgh supplied the name of a reliable maker of auxiliary tubes, and much detailed technical advice on powder and shot and the technique for loading one's own shells.[27] Being a handy man Taverner could make up his own shells to suit his own purpose and to get the best result. He was always ready to try out an "improved" product in order to see its effect in practice. "I used Dupont Smokeless powder in my shells today for the first time and found it very satisfactory — no smoke and very little noise and increased penetration and range."[28] The perfect puff for a new product.

In addition to finding birds, identifying them with field glasses, or shooting them first and then identifying them later with Coues' *Key to North American Birds* and other books, there was also the laborious work of dealing with the dead specimens. In the field it was necessary to stop bleeding from nostrils, beak and pellet holes by inserting a wad of cotton or paper, and sawdust to dry up the blood. The feathers had to be cleaned if possible, and smoothed down before placing the specimen carefully into a collecting bag — though Percy always used a fisherman's creel instead. On reaching camp or home it was necessary to skin and "make up" one's specimens. There was no refrigeration available in the field, and decay and insects would quickly damage them. We have already seen that in the period c. 1894-1900 Taverner did a fair amount of taxidermy work, and that he was reasonably experienced at it. Now, in Detroit, with new opportunities he collected regularly — one might say insatiably — not to earn money, but to enlarge his own study collection. He wanted not only to build up a collection of various species and subspecies but also series of particular specimens, say of breeding females, in order to have a range of examples of plumages with which to identify the birds he was seeing in the field and recording in his field notes. His journals contain many comments on his success, or lack of it. Sometimes he fired too soon — he should have crept farther forward; sometimes he held his fire too long, the bird was frightened by something and flew just as he was about to fire. By late 1905 he was able to report to Fleming: "Have been rather surprised to find I have collected and made nearly five hundred skins this year past. Not bad is it? I have the nucleus of a fair little local collection." By early 1911 this collection had increased to over one thousand skins.[29]

Having skinned the bird the skin was treated with arsenic powder to prevent moths and beetles damaging it later. Professional taxidermists usually suffered from a skin rash caused by this powder, and Percy was no exception. By late 1905 he had a rash all over his face and neck which at first he thought was the result of contact with poison ivy, but later he realized it was caused by the constant use of arsenic poison when preparing his bird skins.[30] Before making up a skin Taverner, as a serious ornithologist, would usually measure the wing span of the bird, and the total length from the tip of the bill to the tip of the tail. He would also dissect the specimen in order to determine its sex, since the plumage of the juvenile male often resembles the female of the species. Also in spring it was sometimes helpful to determine the readiness or not of a specimen for breeding. He might also check the contents of the stomach to discover, if possible, what the bird had recently been eating, and in this way assess its economic value. Having done all this he would make out a label containing the date; his own serial collection number; scientific name of the bird; place of capture; name or initials of collector; any remarks. Only then would he start the process of skinning.[31]

In the midst of all this intense activity Taverner became involved in a new enterprise which gave his own ornithological studies a push forward, and brought a new sense of purpose to ornithology in the Detroit — London region. In the fall of 1904 Fleming was preparing the paper which he was to present at the Fourth International Ornithological Congress to be held in England in June 1905. The subject was on irruptions of Brunnich's Murre [Thick-billed Murre] in Eastern North America.[32] At the same time Taverner was working on an article in which he aimed to present an acceptable hypothesis to explain why numbers of western forms of species that migrated regularly along the Mississippi Valley could also be found as stragglers in southeastern Ontario while in Michigan these forms were not reported.[33] Both men were frustrated by the lack of sufficient data to round out their studies satisfactorily. While Fleming was able to supply Taverner with a few interesting records from the Toronto area for: American Avocet; Snowy Plover; Swainson's Hawk; Le Conte's Sparrow; Nelson's Sharp-tailed Sparrow, Taverner was unable to add anything to the few existing records for the Brunnich's Murre [Thick-billed Murre] in the Detroit area. In their correspondence at this time both men agreed that a survey of the birds of the Great Lakes would be of great importance, that this would have to be carried out by a number of competent observers over a number of years, and edited by one man who could judge the accuracy of their identifications.[34]

Taverner seized this opportunity to put forward a plan that he and Swales had been discussing. Replying to a letter from Fleming he wrote: "You speak of the lack of material for a survey of the Great Lakes. Now it is just to gather such material that we want to start a new club." But how could its members keep in touch with each other, and maintain their interest when they would be living a long way apart? Regular meetings would be impossible. Taverner proposed that it might be a correspondence type of club confined to members living in provinces and states bordering the Great Lakes, and that the club policy should be guided on strictly scientific lines. He went into considerable detail for a proposed organization, explained that the Michigan Ornithological Club would not be a suitable medium through which to publish material ("the club is a club of boys"), but suggested that if *The Auk* would not publish this material, then *The Wilson Bulletin*, which had a good reputation, might do so. He asked Fleming to come to London for a weekend meeting with Saunders and others to discuss the project.[35] During January and February there was a regular exchange of views about forming a club and eventually Taverner, Swales and A.B. Klugh spent the last weekend of February 1905 at Saunders' home. Fleming was unable to attend but was regarded as a founding member because of his keen interest in the project. At this first meeting it was only decided to set up an organization and call it the Great Lakes Ornithological Club (GLOC). A draft constitution was soon drawn up and sent to the five founding members by means of a Bulletin edited by Saunders and circulated from member to member with their comments. No regular meetings were proposed but a field trip to Point Pelee in May 1905 was planned.[36]

The location and climate of Point Pelee makes it a unique natural area. It is a narrow peninsula in the shape of a triangle, situated in the extreme southern Ontario, and jutting some nine miles (14 km) into Lake Erie from its base along the Ontario shore. This is the most southern point of the Canadian mainland and is blessed with a relatively warm climate which favours the growth of a variety of Carolinian forest trees and shrubs. In Taverner's time there were open areas along the west side of the Point where squatters had built their homes and existed by marginal farming combined with fishing and wildfowling. As a result a variety of habitats could be found all within the small space (15 sq km) of the Point — wet and dry hardwood forests, cedar thickets, brushy tangles, dry fields, extensive cattail marshes of various degrees of wetness and containing ponds. In addition there were sandy beaches, with sand dunes on the east side. Among the Carolinian trees and plants were: black walnut, chestnut oak, hackberry, hickory, juniper, red mulberry, western prickly pear, summer grape and buttonwood; all in all a place ideally suited to support a vast flock of birds during the spring and fall migrations.[37]

W. E. Saunders was responsible for identifying Point Pelee as the most favourable locality for field work by the newly formed club. He had first visited the Point in 1882 when he was excited by its flora and fauna — cactus, sassafras, Carolina Wren, [Northern] Cardinal and small flocks of Passenger Pigeons, one of which he collected.[38] He had visited the Point several times since then collecting and making observations, and he realized the uniqueness to bird migration of this slender wedge of land pointing into Lake Erie. Taverner and Swales now heard about these attractions at first hand, and talked them over in anticipation. When May arrived there were two young ornithologists eager for new ground to explore, both fired up with anticipation for the trip to Point Pelee. This is how Taverner described the excitement of that first experience:

> "May 13 1905. At last this trip has come off. It is a difficult place to reach from here. We had to get up, catch two street cars and the ferry, pass customs and catch a 6.15 a.m. train that put us into Leamington at about 7.30. There we waited for Saunders' train at 8.49. He came all right and on time and we took a rig that was to drive us to the east base of the Point … As we left Leamington we passed through a very slightly hilly country the most noticeable features being the stumps of peach orchards killed the winter before last. Stray red cedars showed here and there and the fences were full of White-crowned Sparrows. A little stream or ditch that we crossed was covered over the surface with black evil-odored oil. It was fed from artesian wells the driver told us. We came down a road that struck the point somewhere in the middle and turned towards the east shore. Pretty well across the point as we drove along listening to the various sounds a loud whistling 'chip chip chip r-r-r-r-r' reached us and call[ed] our attention. The horse was stopped and we listened for a repetition of the sound, when we identified [it] as a Yellow-breasted Chat, and a minute after the bird appeared in the thicket just across the fence. The guns were put together and we went after the bird. We worked about for about twenty minutes with the result — 1 Chat taken by Saunders — 3 or 4 more seen & heard, 1 Bob-white seen and a Whiporwill taken by me. The Indigos were common and we watched a couple of males singing on the wing most prettily.
>
> On leaving here we drove on to the shore line & dismissed the buggy."[39]

They now walked slowly down the wide sandy beach of the east shore where the dunes rose up almost devoid of trees except for a few scattered cottonwoods. This was wader and shore-bird ground and here they came across about twenty-five Piping Plover, and many nesting hollows scraped in the sand but none with eggs. Taverner recorded Dunlin, Least Sandpiper, and a full-plumaged male Hudsonian Godwit which he was able to examine in his hands. Terns were recorded; Common, a few Caspian and one Black Tern; also Bonaparte's Gulls and single Herring Gulls flying past.

"Throughout the trip I think Orchard Orioles were more numerous than Baltimores [Northern Orioles] and both were very common. Near six o'clock we passed along the end of the lake [pond] and crossed to the East [=West] shore and made camp. We had supper and measured the birds and made a few of them into skins, then wrapped ourselves in our oil-cloths and, with our feet to the good fire, slept the best part of the night. A Whipporwill called near us and we timed him. He whip-porwilled 15 times in 20 seconds, calling as regular as a pendulum beat."[40]

The place where they bivouacked was near to the present Visitor Centre in the cedars beside the west-shore road — just across from Post Wood. When they woke warblers were singing all round them, Bay-breasted and Black-throated Green being common. After breakfast they loaded their provisions and equipment on their backs and started along the west shore. Taverner continued his journal:

"This side of the Point is lined along the shore with beautiful thickets of red cedar & juniper between. A road runs along here parallel with the lake & separated from it with a screen of this evergreen. ... On the inland side of the road are broad fields — sandy but supporting a thrifty-looking farming community. There are farm houses at intervals all along here until the lake and the marsh behind it approaches too close to the lake shore to allow of cultivation. This is in striking contrast to the other side where there was but one building to be seen the whole way."[41]

He noted a suggestive feature of each farm house was the array of pound nets hanging in the yard showing that the farmers combined farming with fishing. As they walked Taverner was taken by surprise. "I never saw so many warblers in my life." In one big walnut tree he noted: 2 Bay-breasted, 1 Parula, a Myrtle, a Magnolia, a Redstart and 2 Blackburnian Warblers. "The fauna is peculiar, Carolinian. Not long after starting I found a lot of cactus growing in the sandy meadows." In the margin of his journal he drew a sketch of one. [Northern] Cardinals were not uncommon and a Connecticut Warbler showed itself. Later Swales and Taverner watched a Bald Eagle with "a superb white head and tail" which a Kingbird was harassing, diving at it persistently. Through his glasses he saw two eaglets in the nest. By now it was time to be thinking of returning home — on foot, not by vehicle. "We started in towards Leamington about dark. It was a six mile tramp and tired as we were with the unusual load on our backs it seemed like sixteen to us. However, about 9.30 we arrived there & put up at a hotel. Had a good cold bath & rub down and were soon asleep in a good bed and far more snugly ensconsed than we ever expected to have been in such a small town."[42] It had been a memorable trip for the three of them even though during the day Saunders lost his purse, and Taverner lost his pipe — "a major calamity in times of stress".[43]

The Great Lakes Ornithological Club was now launched, its second Bulletin was circulating to its six founding members during May, and another trip to Pelee was planned for the fall of 1905. This was a more ambitious venture, planned for a fortnight, in order to give ample time for observing the fall migration, and a tent was rented from a London (Ontario) firm.[44] Saunders and Barrows hoped to come but Fleming was doubtful.

Taverner devoted thirty pages in his Journal to recording the events. It was headed, rather grandly: "Sept. 4. 1905. At Camp Coues, Point Pelee, Essex Co. Ont."

"Made camp here today. Klugh is the only one of the crowd that finally showed up. Barrows and Saunders have, I fear, finally backed out & Swales is detained by business for a few days. I hardly expect that Fleming will get here. Klugh is greatly interested in the botany of the locality and is discovering a treasure at every step. Never saw as many raptors as are to be seen about here. One or more hawks are continually to be seen — more Sharp-shinned, I think, than any other though the Sparrow [American Kestrel] & Red-tailed and Marsh Hawks [Northern Harrier] are in evidence. This seems just as it should be expected. Down the road on the west side is coming a continual stream of warblers."[45]

They had camped in the same place as in May, among the Red Cedar close to the west shore of the lake.

This was valuable learning experience for Taverner because there were so many birds intent on their feeding so close at hand and so little alarmed by human beings, even when they were carrying guns; also because he had plenty of time to collect specimens, take them back to the nearby tent, study their plumage, skin and dissect them. The perfect holiday for a young ornithologist. For instance, he collected a Chipping Sparrow and thought from the streaked appearance of the crown that it was an immature bird only to find on skinning it by the complete ossification of the skull that it was an adult. From a look at Jonathan Dwight's *Passerine Plumages* he gathered that this was the normal fall plumage of the species. There were no professional and highly experienced ornithologists visiting Point Pelee at that time. W. E. Saunders was the best person for identification, but when he was not there Taverner and Swales had to do their best with their own resources. At least they could bring their skins home and hope that Saunders or a professional at Ann Arbor would be able to identify them with certainty. In the middle of this intense birding Taverner was alert enough to spot a plant in flower that he did not recognize. Klugh identified it as *Apios tuberosa* — ground nut. A major migration wave must have come in during the night for in his Journal for 5 September he reported:

"Today the first day [of] field work at Camp Coues. Got up about 6.30 and searched along the road running in front of the camp. Never saw birds so thick in my life over such an expanse of territory. Usually in the fall the warblers cruise about in companies but here on the point the whole place seems to be occupied by one large company."

While Taverner found Blackpoll the commonest, with Magnolia, Blackburnian and Black-and-white Warblers plentiful, Klugh wandered off into the shrubbery bordering the cleared land nearby and collected a rarer warbler — a Connecticut.

The long account Taverner wrote of their fortnight there is full of the exploring they did along the east and west shores, in the dry fields, the marshes and lakes within them, the wooded areas and the tip of the Point. It is also a vivid and detailed account of the birds they saw, collected, or failed to collect, with sometimes a reference to plants or insects. To read it is rather like spending time in September at Point Pelee oneself, among that special habitat of sand dunes, dense bush with climbing vines, wet thickets and marshy woodlands. Here among many other species they found Carolina Wrens, a juvenile Prairie Warbler, a male [Northern] Cardinal in moult and a King Rail.[46] Another day they came across juvenile Carolina Wrens which constituted the first record of breeding in Ontario.[47]

Swales joined them on 7 September. Although the warbler wave had moved through the Point, nevertheless during the next few days, between them, they found: Ruby-crowned Kinglet; Brown Thrasher; House Wren; Olive-backed Thrush [Swainson's Thrush] and a few Gray-cheeked Thrushes among other birds. They now explored the extreme end of the Point and found the habitat very different.

> "The large deciduous trees end about half a mile or so from our camp & the whole end of the point is covered with the same red cedar, scrub & juniper that clothes the rest of the west shore. Here we found warblers common again. It is interesting to see how the numbers have varied. The day after we came we found the woods alive with warblers. The next day there were as many. The day after they were slightly fewer and today, in the vicinity of the camp, they were all gone but still quite a number [are] left at *the extreme end of the point* as though they were but leftovers that had reached the jumping off place."[48]

On the east coast, on 15 September, they collected a bird that they could not recognize. Back in camp, with the aid of Coues' *Key*, and much difficulty, they tentatively called it a [Red] Knot, but knew that it would take further study to make certain of their identification. This is a good example of the difficulty facing field ornithologists of that period in identifying birds with reasonable accuracy. They lacked specially designed pocket field guides with well coloured illustrations that they could carry in the field with them. With glasses still limited in field of vision and clarity of light the serious student of ornithology had to collect specimens in order to bring them home for study with the *Key*, and to compare them with skins in museums and private collections. It is worth saying again that descriptions and illustrations in the high-grade field guides that enthusiasts use today were developed from the skins, in various ages and plumages, of specimens that were collected at the time Taverner and his friends were exploring and collecting at Point Pelee and elsewhere. *They could not have been written and illustrated from sight records.*

A few miles southwest of Point Pelee lies Pelee Island, with a somewhat similar land formation and vegetation. Here Lynds Jones spent a week in the fall of 1905 making observations on the islands, four days being spent on Pelee Island. He described the migrational conditions as follows:

> "I found the birds migrating practically everywhere along the line of the islands, but the largest and best defined stream was across Pelee Island, with a well marked convergence to its southern point, thence across to Middle [Island], and beyond to Kelley's Island, thence across to Marblehead. ... No birds were seen crossing the lake except in a line with the islands."[49]

Lynds Jones was invited to join the GLOC and in his letter of thanks for "the privilege of joining with you in this very effective way of keeping in touch with other bird lovers", said how glad he was to be cooperating with them in their survey of the area.

> "My studies of the birds and plants of the islands makes it clear that the lake is a great climatic levelling factor upon the portions of land bordering it."[50]

What Saunders and Jones already suspected was borne out by the experience of Taverner, Swales and Klugh during the fall migration of 1905, namely that Point Pelee served as a migration funnel in the fall for the much wider hinterland north of its base, while in the spring it again acted as a funnel for a concentrated mass of birds which then spread throughout the much wider area to the north of its base. To Taverner and Swales this was an exciting discovery, and presented them with a challenge that would require much close study over the next few years.

The first task they set themselves was to compile an annotated list of the birds of Point Pelee. Taverner wrote to Saunders proposing that a list of the birds of Point Pelee should be undertaken, and asking for his help and criticism in compiling it.[51] He realized this would be a major undertaking, but one that badly needed doing. It was agreed that members of the club should receive recognition for their observations while the actual preparation of the list should be done by Taverner. In a letter to Fleming Taverner wrote that he wanted to make it more than just an annotated check-list by expanding on the biological importance of Point Pelee to naturalists as a northern pocket of Carolinian influence and its importance as a migration route. Taverner presumed that he would be sole editor and that Swales would let him use the observations Swales had made at Pelee during their past visits. But Swales wanted it to be under their joint authorship so that he would receive an equal share of the credit. Taverner wanted to draw a number of generalizations from the check-list which would be his alone. As he frankly told Fleming, from a purely selfish standpoint he wanted to write the list

himself so as to show what he could do. This led to a certain coolness between the two men but there was little chance that their conflicting aims would seriously endanger their friendship. They each needed the companionship of the other. Both appealed to Fleming for advice, who suggested the basis for a compromise which they accepted, and their tiff in a teacup soon subsided. Taverner recovered from his disappointment at having to publish the Pelee list under joint authorship, and in *The Wilson Bulletin* rather than in the better known *Auk*.

Among the various topics discussed in the early issues of the Bulletin was one initiated by Taverner on "The Tagging of Birds". Before moving to Detroit in March 1904 Taverner had already become interested in the possibilities of learning more about migration and distribution by "tagging" birds with bands on their legs. Although he did not originate the idea himself his practical mind turned to a workable method for applying it as widely and effectively as possible in North America.

Stimulated by the new opportunities open to him in Michigan he wrote to the editor of the *Bulletin of the Michigan Ornithological Club* pointing out that valuable information might result if birds were systematically tagged. He suggested that if those undertaking field work were to tag each young bird they came across, while older birds were trapped and tagged in the shrubbery of one's immediate neighbourhood, results could be obtained with the minimum of time and labour. He explained the kind of bands he proposed to use for small birds, how they would be marked, and the results recorded. It was certainly a bold scheme and showed considerable optimism on Taverner's part. In a letter to *The Auk* he wrote:

> "Mr. P. A. Taverner, of 95 North Grand Boulevard, W., Detroit, Michigan, proposes to attach small aluminum bands to the tarsus of young birds, in the hope that some of the birds thus tagged may afterward fall into the hands of ornithologists and be reported. The tag, for the sake of brevity of address, will be inscribed 'Notify the Auk, N.Y.,' to which any such discoveries should be reported for publication."[52]

In this way the American Ornithologists' Union, through its journal *The Auk*, was associated with bird banding in America from its earliest stage. Also, in a hand written note dated 30 March 1905 he gave an account of his own involvement in bird tagging to members of the GLOC in its Bulletin, and a summary of attempts to carry out banding in North America to that date. With this he included sketch plans for a brick trap for catching ground haunting birds. Fleming was responsible for using the first numbered and recorded band in Canada. His Journal for 24 September 1905 reads "In the garden in the afternoon I caught a Robin [American Robin] which I will release with a ring Number 1."[53]

Taverner supplied thirty tags to Fleming, fifty to Klugh and twenty-eight to Saunders in May 1905. But the mere handing out of bands was of no significance, and it was with a note of pride that he made an announcement in the GLOC Bulletin of January 1906 that a banded flicker [Northern Flicker] had been shot and the tag returned by the finder. This warranted a notification under "General Notes" in *The Auk* which read:

> "*Tagging Migrants.* — In accordance with the scheme outlined in "The Auk," XXI, p. 410, I have been placing aluminum tags upon the tarsus of nestling birds, and have induced others to follow my example in the work. This past spring several field workers have been using tags supplied by me and this winter the first result has been attained.
>
> May 29 Mr. Chas. Kirkpatrick of Keota, Keocuck Co., Iowa, tagged a nest of half grown Flickers (*Colaptes auratus*) near his home. Dec. 25 Mr. J. E. Ross took No. 123 of this series at Many, Sabine Co., Louisiana. The bird was not saved but I secured the tag from the collector and have identified it as one of my issue ... "[54]

Between May 1905 and June 1908 Taverner appears to have issued about four hundred bands.[55] Though the return address was printed by means of a die the number of each band had to be done by hand. Taverner found that hand numbering was too laborious to be practical. When during the winter of 1907-1908 a bird club in New Haven (Conn.) was organized for the purpose of banding birds, Taverner volunteered to hand over his records and bands to the club and to act as an advisory member of its committee on banding.[56] At the meeting of the American Ornithologists" Union in November 1908, Dr. Leon Cole called the attention of members to the value of tagging as a means to obtaining information on the movements of individual birds. In this paper he reviewed the work done by Taverner, himself and others to that date.[57]

Although Taverner ceased active banding in 1908 another individual effort began near Leamington, Ontario, the following year. The event was recorded in *The Auk* (1910) by W. E. Saunders under the title "Another tagged bird heard from". He reported that Mr. J. T. Miner of Kingsville, Ontario, had a number of wild ducks in semi-domestication along with geese and pheasants. In the fall of 1909 his Black Ducks attracted a wild one of that species on 5 August. It soon became very tame and was banded. It was free to come and go, but did not migrate until 15 December. It was shot in South Carolina on 15 January 1910 and the sportsman who found the band returned it to Mr. Miner.[58]

During his years in Detroit Percy was continually reading and thinking about ornithology. He had read and re-read Darwin on the evolution of the species, so when, in a letter, Fleming claimed that ornithology, as it then existed, was not a science he forced Taverner to set down his thoughts on the subject clearly. This he did in a letter of November 1905. The work that ornithologists do rarely has great sig-

nificance, he argued. Yet even the collection of data is of value. At this point Taverner launched into an eloquent exposition of science as the key to the plan of creation.

> "Strictly speaking there is but one science — the science of the plan of the creation. Some study it in the stars and are astronomers, others in the earthly strata and are geologists or in the different forms of life and are zoologists. Only by piecing together the results of all branches will we ever hope to reach the ultimate goal — that of a perfect understanding of the creation. The advanced studies of one age are the primary ones of the next and it is only by working out the minor details of the broad base of the pyramid that we can ever hope to achieve and locate the capstone above.
>
> Our little data help solve questions of distribution and hence dispersal of life. This, when thoroughly understood will undoubtedly throw some light upon the origin of life. The great problem then will be the origin of matter. We are attacking it from all points — astronomy, chemistry, physics, entomology, bacteriology, geology, botany and perhaps last of all ornithology. No matter how little the light is that it throws upon the great question — if it throws any or if it even promises to do so it is a science. I hope I have made myself clear. Perhaps you will see why I am not interested in the so called Life histories of birds and why I am interested in the speculative side of things. To my mind the mere collection of data and records with no other end in view is on a par with a collection of postage stamps or tin tags. As it is I look upon every little fact that I record as a possible aid in the solution of a problem that may in an infinitesimal way help to answer what are we, where did we come from, where are we going, and why are we coming or going so? It has been said The only study of man is man. I say the study worthy of man is this creation and if I am only aiding that study in the most microscopic way I feel that I am doing scientific work and ornithology is a science. Q.E.D.
>
> There my mind is relieved. I have lectured all evening in a most pedantic manner but I feel easier."[59]

Although these ideas are in no way original at least they show that he was reading about science and creation, and thinking about the subject.

Another problem which was much on Taverner's mind at this time was concerned with nomenclature and the system by which the AOU Check List of North American birds was kept up to date. A particularly contentious problem concerned the growing number of subspecies distinguished by taxonomists. Taverner discussed with his friends the harm which he felt was being caused to ornithology by creating too many new races within a species, each with its own separate name, based on only slight variations. This was a highly technical question and one that a novice should have had the sense to avoid but Taverner did the opposite.[60]

He wrote to Dr. J. A. Allen of the Department of Mammalogy and Ornithology at the American Museum of Natural History in New York. Allen was a founder of the American Ornithologists' Union and its president for the first seven years of its existence. He was also the editor of *The Auk* and was much involved in the problems of nomenclature, and the efforts to stabilize scientific names and the style of the AOU Check List. At this time Allen was fifty-eight years old and was looked up to as perhaps the most influential ornithologist of that time. Taverner certainly went to the top authority in presenting his dissatisfaction with the system of designating subspecies. He must have foreseen the consequences and was either too sincere, or too foolhardy to flinch from his purpose. His letter began with a claim to be presenting the views of ornithologists of the "Middle West" concerning some modifications he wished to see made to the format of the next edition of the Check-list (Third Edition published 1910). He proceeded to make a number of criticisms.[61]

This was a challenge to the authority and wisdom of the AOU and the working of its committee on the nomenclature of North American birds. Taverner compounded this by implying that the committee had accepted a large number of subspecies which it had subsequently found necessary to discard. Allen replied with restraint while refuting what Taverner had written. This should have quietened Taverner but it did not. He was foolish enough to raise the issue again. This time Allen spoke sharply and put him in his place.

> "I cannot discuss so large a subject as the law of priority and a statute of limitation in a letter. The best I can do is to send you a copy of the A.O.U. Code and call your attention to the discussion there given of both these topics — pp. 32-39. You may have seen this already and if you have it would be doubtless a waste of time for me to say more.
>
> Now let me be plain-spoken. I take it that your actual experience in working out questions of nomenclature has necessarily been quite limited. You are disgusted with changes of names and are looking for some easy way to get rid of such annoyances. Do you reflect that hundreds of others, for the last fifty years, have had the same disgust and annoyance, and that in the light of a hundred-fold more experience and in every way a much broader equipment for the consideration of such questions than you have had, have almost unanimously reached the conclusion that the law of priority is the only basis of hope for future stability in nomenclature? No statute of limitation can be formulated that will receive general approval. The matter has been up before and thoroughly considered, with the result that such a proposition has been overwhelmingly disapproved as wholly impracticable."[62]

Eventually Taverner accepted the law of priority but he never gave up challenging any subspecies that, in his opinion were determined on very flimsy grounds. In this he showed another side of his character — an extreme stubbornness in the face of authority, or as some people felt, a strong streak of perverseness.

The Taverners lived in rented accommodation when they moved to Detroit in March 1904. A year later they moved to another address, and six months later to yet another address. Percy did not complain

about accommodation in his letters to Fleming, but he must have felt at a disadvantage when he compared his rooms in other people's homes with his friends who had homes of their own. Both Percy and his mother wanted a garden of their own which they could tend year by year and which would repay them simply by flourishing. But how to achieve it?

There was only one way that would quickly solve their problem, and that was to sell the cottage and land on Gibraltar Island in Lake Muskoka. It was a sad decision to make — the three had been going there fairly regularly since 1887 — but it was an obvious one. They now appeared to be permanently settled in Detroit, and since they spent almost the whole of each year living there it made sense to raise the capital for a home of their own by selling the cottage and land.

This task fell to Percy as a man who had some acquaintance with buying and selling property through his work in an architect's office. He wrote to Edward Prowse, proprietor of the Beaumaris Hotel, enclosing a plan of Gibraltar Island, and asking if he could dispose of the lots which he had numbered. In reply Prowse said that he might have found a buyer, someone who offered $1300 for the two lots, Point Coo-ee and Kamp Komfort, or $2000 cash for all the island except the lots already sold. Percy made further enquiries, writing to Fleming and to John Brashear, his friend and neighbour in the Beaumaris cottage community, about his plan to sell. Brashear replied that an advertisement put in any one of the Pittsburg newspapers might bring a purchaser.

Eventually the cottage and land were sold for $2500.[63] Percy went to Beaumaris in June 1906 to clear out their possessions, and by taking an early train from Windsor was able to spend three hours with Fleming in Toronto at Spanner's shop where they "talked ornithology". Thence to Muskoka wharf birdwatching from the train as he went (he saw a Red-headed Woodpecker at Guilford) and then by steamer to Beaumaris. The next day he went for a ramble in the old familiar area round Camp Comfort. He saw a male Purple Finch in bright plumage which was probably nesting nearby, found the nest of a Wood Thrush with eggs and saw [Dark-eyed] Juncos feeding Cowbirds. One Whip-poor-will was calling in the evening.[64] So Percy said goodbye to the only permanent home that he had known up to this point in his life. What his feelings were we can only guess since nothing in his journal nor in his surviving letters gives a clue. But he had recently turned thirty-one years old and needed a home where he could plan for a more comfortable and permanent way of life for his mother, sister and himself.

With the money from the Muskoka property Percy and his mother were able to buy a house and garden in the village of Highland Park just outside the boundary of Detroit city. The address was 55 Elmhurst Avenue, Highland Park, Michigan, and the purchase price was $2900. Although closing day was fixed for 1 July 1906 the Taverners did not get possession until early September. This was frustrating since it meant they had to remain in rented accommodation in Detroit through the hottest part of the summer just when they thought they were moving to the countryside. Percy was doubly annoyed because, as he wrote to Fleming, the move would occur right in the middle of the fall migration when he wanted to be at Pelee. Even after they got possession their problems were not over since they discovered that the contractor had not fixed the locks of the house properly, there was a leak in the roof and the toilet had not yet been installed. From the initial agreement it was clear that the property formed part of a new subdivision which was still in the process of completion. The vendor agreed to build walkways round the house and a fence on each side, and to put down sod from the rear line to the street line. Also he agreed to supply a water closet to be placed in the basement.[65]

At last Percy was able to tell Fleming of his change of address which drew a sly witticism from Fleming at Percy's expense in a letter which began "I trust the statute of limitation will apply to your address: none other to be published for 10 years."[66] This was what Taverner also hoped but just as he and his mother and sister were settling into their own home outside the city he received a letter from Fleming, mainly about birds, but ending with this cryptic sentence: "I have a matter I want to talk over with you and hoped to have been able to see you, as it may be of importance but I will have to put off referral to it tonight."[67] This aroused Taverner's curiosity and in a letter containing questions about how to start a garden at the new house, he asked "What is it you want to talk over. You say that it may be of importance."[68] Fleming's answer, when it arrived, was totally unexpected and fell like a bomb in the Taverner household. For the first time in his life Taverner heard that there might be a chance for him to exchange the career of architectural draftsman for that of professional ornithologist.

On a recent visit to Ottawa Fleming had met with John Macoun, and it was at this point that the future career of Percy Taverner came into the orbit of forces shaping the newly emerging Victoria Memorial Museum. Until then Taverner's only contact with Macoun had been by letter containing bird notes that the "Professor" had invited him to send. This had been a discouraging experience for Percy who was upset by Macoun's apparent laxness in acknowledging his contributions to the *Catalogue of Canadian Birds*. [See Chapter 3]. Taverner, however, was unaware of the difficulties that the natural history branch of the Geological Survey faced through lack of staff and inadequate funds.[69]

In the fall of 1906 prospects for the museum were not very encouraging but at least there was some sign of forward movement. In a letter to Taverner Fleming said that A. P. Low, newly appointed Acting Head of the Geological Survey,[70] intended to get rid of its taxidermist, Samuel Herring. Fleming had heard this from Macoun who also told him that:

"They want some one to take hold of the museum, not necessarily a taxidermist, some one of sufficient artistic taste and the needful knowledge to arrange the new museum and take the burden off the hands of the present staff. In fact they want a curator but there was nothing said about salary only that the appointment lay between Low and himself and they wanted the right man …"

In the final sentence he said:

"Write soon and best tear up the letter light your pipe with it."[71]

In his reply Taverner said he realized it was only a pipe dream as yet and might never materialize, and that he and his mother and sister had only just settled in Highland Park.

"Though I am a single man I am far from free to do just as my fancy dictates. I am as necessary to my mother and sister as they are to me."

He then stated his own position.

"I have always wanted to do museum work and think that I have some of the qualifications for it. If I ever achieve anything it will be along such lines. Architecture will never offer me anything but a living as I do not take enough interest in it to develop any latent talent I might have in that direction. However I am no longer a taxidermist. I do not care to do a taxidermist's work and beside were it otherwise the effect of the arsenic upon me would render it impossible for me to do so regularly … As for remuneration, I know that there is no great fortune to be made from such positions but of course I should expect anyway as much as I can make draughting. Twelve hundred a year would be a minimum but I think that such a sum coupled with the idea of doing congenial work would be a large inducement. Were I alone in the world I am afraid that a smaller sum with a permancy and the thoughts of the pleasure of the work would be more than I could resist."[72]

A few days later it was no more than a pipe dream, when Fleming received a letter from Low stating that what the Geological Survey wanted was a practical taxidermist; that in those circumstances Taverner would not be suitable for the position.[73]

In a letter which shows Percy's trait of modesty (some might call it lack of confidence) he wrote a detached self-appraisal.

"Now in the first place you overrate my ability as an architectural designer. I am not a good designer. I have done some good little things but they were more the inspiration of the moment than a good criterion of my general ability. No one knows my failings in this line better than myself. In the steady grind of office work I am not there with the goods. I am a good draughtsman and do not think that I need be out of a position for any length of time. Neither am I good for the outside work — I am the worst handler of men possible nor can I hustle for business. So I can therefore see no prospect of success in any business of my own or in partnership in any. As things are I do not want it either. I am able to make a comfortable living as it is and can expect a slow perhaps but steady advance in salary without the worry and fret of business responsibility. My present employer is a slave to his business — I don't want any of that. I intend to get as much out of this life as I can and do not think that I can do so in a race after money. All I want is enough to live on and that I think I can get. Were I a married man I should of course look on things differently."

He agreed with Fleming in the matter of clothes, that he should pay more attention to his appearance. He admitted to absolute indifference to what other people thought of him, and confessed that he was bored by people from whom he could not get a single intellectual spark.[74]

Life in the Taverner household resumed its normal course. Percy could turn his mind "back to the drawing board" (literally) while finding a very congenial outlet for his surplus energies in the satisfaction he obtained through ornithological projects and, from now onwards, in gardening. Mrs. Taverner could look forward to indefinite time for herself and her family in the new home, as well as in creating a garden of their own. Since Percy had no previous experience of gardening he relied initially on advice from friends, especially from Fleming whose practical experience was useful.[75]

As for Fleming's sound advice on getting a better job in architecture this may have had some influence on Percy in spite of his strong views on not wanting to get into a "race after money" and not being "a slave to his business". From what scanty information exists on his professional work it appears that he changed firms in 1906 and, that by the time of writing his letter of self-appraisal on his ability as "an architectural designer", he was working for William E. N. Hunter who had an office in Detroit from 1906 onwards. Taverner is listed in the Detroit City Directory of 1906 (dated August) and in the 1907 Directory as working for W. E. N. Hunter. This was the man he referred to as "a slave to his business".[76]

For Percy Taverner his first two-and-a-half years in Detroit marked a considerable change in his way of life. These years were ones of much wider scope and deeper satisfaction in his chosen recreation of amateur ornithologist. His life now was full of interests and opportunities thanks to his passion for bird study. By the end of 1906 he had made some progress in his bird banding scheme, had carried out collecting and record keeping far more extensively and systematically than previously, and he was working on a major study of bird migration and distribution in one unique geographical area of the Great Lakes. Also by late 1906 his home life was more comfortable and satisfying than at any time previously. As well, he had caught a glimpse of what he might possibly achieve in the future, with good luck and hard work: a professional position in a natural history museum. The challenge he now faced

was to produce a solid and worthwhile bird study which would be published in a good ornithological journal, *and* to extend very considerably his own knowledge and experience in the world of ornithology. The next four years at Detroit were critical for Taverner and his future career; they were what might be called his "ornithologist-in-the-making years".

The Great Lakes Ornithological Club gave Taverner, Swales and a few others a reason to visit Point Pelee regularly, to keep systematic records of their sightings and collecting, as well as to "write up" material in the Bulletin.[77] One obvious by-product was recording species not previously known at Pelee and rare in Ontario. For instance Fleming, on one of his infrequent visits to Pelee, collected a Chuck-will's-widow, the first record for Ontario.[78] Taverner was responsible for the first Canadian record of a Blue-winged Warbler, taken there in September 1906[79] ,while the first [Northern] Mockingbird recorded at Point Pelee was also collected in 1906.[80] The movement northwards of the [Northern] Cardinal into Canada from the American side of the border had hardly started at the beginning of the century, but the records kept by members of the Club allowed the authors of "The Birds of Point Pelee" to claim, in 1907, "Point Pelee and its vicinity boasts of being the only locality in the Dominion of Canada where the Cardinal is regular and common."[81] The first record of the Bewick's Wren at Point Pelee dates from 1909.[82]

Although Taverner was not able to visit Pelee more than a few times each year he obtained useful information and a succession of specimens from Bert Gardner, a resident wildfowler on whose land members of the GLOC camped and where, in 1908, they built their shack.[83] One spring Taverner brought back from Pelee an injured male Wood Duck which Gardner had saved. Writing to Fleming he said: "It is doing well and is the gentlest and prettiest little pet you ever saw." At the end of the letter he wrote: "Have just given my Wood Duck a bath in the tub and you should see how he enjoys it."[84]

Percy had kept some pets while living in Port Huron but it was only now, when they had a home and garden of their own, that he could keep birds as pets. In another letter to Fleming he wrote: "I have a tame Sparrow Hawk [American Kestrel] now. He is very tame and will stand all the handling we want to give him. His favorite perch is on my head but it is not quite safe to let him stay there. He has never been house-broken.[85]

Although Taverner shot birds as specimens for his study collection, or for exchange for other specimens, there is no evidence that he enjoyed shooting them as a sportsman. Nor was he free to shoot birds whenever he liked, and at Point Pelee he had to have a permit ready to show the game warden. To obtain a permit, he needed a form signed by two people certifying that he was a proper person to collect for scientific purposes. Writing to ask Saunders to endorse his application he reported:

> "For the first time in my life I had to show my permit to the game warden. Someone in Leamington had complained on us and he had to question us. He did not notice, however, it had expired — lucky for us."[86]

Swales, also, had been in the habit of getting Fleming to endorse his application, but the warden refused to issue him one.

> "If Taverner can have one over here I don't see why I can't especially as I have considerable property in Canada."[87]

His feeling of injustice was all the more because Taverner had been issued a permit to collect for scientific purposes in the State of Michigan by the game warden stationed at Sault Ste Marie.[88] But the matter did not end here. The game warden tackled them at the Point in the fall of 1907 and warned them against shooting at a mark even, on Sundays. Taverner explained the reason to Fleming. "I think some of the people in Leamington complained on us. They cannot understand any one preferring to shoot small birds instead of ducks. I imagine that they think that we used the permit as a cloak to other shooting."[89]

From the correspondence and records that have survived among the Taverner, Fleming and GLOC papers in the Royal Ontario Museum one can get an idea of Taverner's continuous ornithological activities. From the fall of 1906 there was the immediate vicinity of his new home to explore, as well as regular expeditions with Swales to such places as St. Clair Flats, the Ecorse mud flats and the Huron River at Rockwood. Weekend excursions were made to Point Pelee with Swales several times a year, as well as the annual camps there. Although telephone communication at this time was not sufficiently developed to make possible the equivalent of the birding "hot-line" of today it was easy and quick to send a postcard with a useful tip-off of recent arrivals. For instance Saunders sent Taverner a card from London in November 1906 which said:

> "Look out for W. W. Crossbills [White-winged Crossbills] on Hemlocks. I got 9 out of 50 yesterday."

It cost one cent to send and reached Taverner at Highland Park, Michigan, the next day.[90] Not only was Taverner very busy collecting birds, dissecting their organs for information, and making notes of what he observed — what he referred to as "field work" — he also spent time regularly on writing up his Journal from notes, and keeping up his species ledger. His journal and species ledgers are still of value for information they supply on distribution of particular species. For instance, a species that is now a very rare permanent resident in southwestern Ontario — the Bobwhite — was even then subject to fluctuations in number. After birding in March 1907 with Swales he noted in his Journal that the most interesting species seen was Bobwhite. They saw a covey of twelve. These were the first quail that he had seen in the county of Wayne since he arrived in

Taverner preparing a skin in the Great Lakes Ornithological Club "shack" at Point Pelee, 30 May 1909. Photograph by *Detroit News Tribune* (now *Detroit News*) 27 June 1909. (Reproduced from print courtesy of the Royal Ontario Museum, Toronto.)

the spring of 1904. The winter of 1903-04 pretty well exterminated them in southern Michigan.[91] We can also learn a little about conditions of life on Point Pelee from his Journal. There was a lifesaving station on the west side of the Point. In November 1906 a ship was driven ashore in a storm and the local Life Saving Corps took eighteen people off the hulk.[92] The tower near the tip of the point was used not only as a lookout but also as a very convenient place from which to view the fall migration.

Fleming was very concerned about the effects of alien species on native species in North America. He was especially worried about the spread of [European] Starlings and wrote: "I see *Bird Lore* is discussing the Starling question. The harm has gone too far to stop and I foresee the passing of the [Eastern] Bluebird. Urban ornithology of the future will consist of English Sparrows [House Sparrows], Starlings and possible Jackdaws. The Swallows and Martins will go."[93] An overly pessimistic forecast. From what both Taverner and Swales wrote they were both careful not to accept records of birds seen without supporting evidence. Taverner was suspicious of the reliability of John Clare Wood of the Michigan Ornithological Club,[94] while Swales was very critical of Lynds Jones', "big days" when he and one other would claim to have seen as many as 130 different species without any proof to show for it.[95] Taverner's point of view was clearly stated in his Journal when he wrote that he had shot a Carolina Wren, the first authentic specimen for the county, and one of the first for the State of Michigan.

> "In this respect I class nothing as absolutely authentic unless the specimen has been taken and viewed by some one of undoubted authority.[96]

He regarded taking a bird's life as a necessity when a specimen was required to authenticate a record.

One other use of his Journal was for him to record ideas and problems which he considered needed further study. For instance while at Point Pelee in early 1907 he collected two very pale-coloured Great Horned Owls. He was already aware of the wide difference in the colour of plumage of the owls, and now, looking at them closely, he wrote to Fleming:

> "I think that the distribution of the Horned Owls will have to be studied with breeding birds. The[y] migrate largely and in the winter the forms must be pretty well mixed up. There seem to be but few breeding birds in collections."

In other words it is not possible to make a reliable study of the breeding distribution of a species or particular form (e.g., western or northern Great Horned Owl) in a region by using records from only winter months or during migration. They need to be based on records made of breeding birds of that particular region.[97]

During this period ornithology had become, for Taverner, a serious undertaking, a semi-professional occupation more than a recreation or a hobby. Taverner's ambition was to write a major paper that would make use of the material he had been collecting since coming to live in Detroit. He wanted to prove that he could write about birds in an extended work, and he wanted to have that work published in a journal where it would be read by the majority of serious ornithologists. The subject he had in mind was an annotated list of the birds of Point Pelee; the journal he aimed for was *The Auk*.

Before examining "The Birds of Point Pelee" it may be helpful to say something about Taverner's ability to write well at this time, and also to discuss his collaboration with Swales as joint authors. Two extracts from his Journal will show his powers of description. Here is a female Wilson's Phalarope observed through glasses in May 1906.

> "It floated very high in the water and glided about without any signs of effort striking right and left with its graceful straight bill like an expert fencer handling his rapier. It seemed to be continually picking up food from the water and its head was constantly going as it struck with a thrust-like action of its bill on either hand."

He then described its plumage with the diagnostic marks.

> "I saw the dark of the back of the neck shading into red on the sides and with the pearl grey of the median stripe on the head — I watched it for nearly half an hour ...."[98]

By contrast here is a flock of Semipalmated Sandpipers in flight.

> "As a clock they flew as with one mind wheeling absolutely together and wheeling at the same angle on the turn. One instant there would be a mass of scurrying brown dots looking like a bunch of mosquitos in the distance then the next moment they would wheel and the brown dots would simultaneously flash into snowy whiteness in the sunshine. In such times the glistening underparts would fairly dazzle the eye with their whiteness. Often they would slow down and lower their elevation and I expected they would alight but no they sailed past the seeming destination and were wheeling again and making for the other end of the place."

When finally they landed he described them feeding.[99] A different style of descriptive writing is used by Taverner in his article "The Yellow-breasted Chat. A character sketch", which was published in *Bird Lore* in 1906, with a drawing by Taverner of the bird during its flight song. The style here stands out as anthropomorphic and literary; completely out of keeping with the aims of present day ornithology.

> "The Chat is a will-o'-the-wisp, it plays hide-and-seek with you just out of sight behind the foliage, it taunts you fearlessly with its private opinion of you, your family, and all your ancestors . . ."

and much more in this vein. It is intuitive, arch, deliberately playing for effect.[100]

But we need to remember that *Bird-Lore*, founded in 1899, was dedicated to the study and protection of birds, and was intended mainly for Audubon Society members. Taverner's perception of the average Audubon member *at that time* was coloured by Fleming's view of them as a bunch of elderly ladies

who tended to "gush" about the dear little birds.[101] Taverner was anxious to have his article and drawing published so he wrote it in his literary style. When Frank Chapman's *The Warblers of North America* was published in 1907 he quoted from Taverner's description of the chat's flight song.[102]

In addition to an occasional "purple passage" Taverner's style was marred by a tendency to be too long winded. A fellow member of the GLOC, William Brodie, expressed it neatly when he noted on one of Taverner's frequent contributions to the Bulletin:

> "Friend T. may remember sugar making in Muskoka. If so he must know the necessity and virtue of boiling down."[103]

If Taverner had been trained at a university he would probably have had these tendencies towards over-writing eradicated. Instead his friends and acquaintances performed the same service. Another side of his written style can be seen from the many letters he was constantly writing to his friends. Here the style is usually colloquial, written as he might speak, often with a bubbling sense of humour, the equivalent of a twinkle in his blue-grey eyes which those who met him remembered. Percy was impeded in expressing his ideas verbally by his stammer. There was so much that "turned him on" in the natural world, so much that he wanted to communicate to others, that he was forced to compensate for his stammer by setting it down at length in writing. His letters and bird journals were his way of expressing his sense of excitement and appreciation of the beauty of the natural world and some of the unexplained ways in which living things interacted.

Swales and Taverner went together to Point Pelee for the 1907 fall migration from 24 August — 6 September. Their friend Norman Wood, from the Natural History Museum of Michigan University went with them. Saunders joined them "bringing with him Mr. J. S. Wallace of Toronto, a beginner in the bird business but an experienced camp man who proved to be quite an acquisition in more ways than one."[104] Taverner and Swales both kept bird journals. Comparing them for style and content one sees a wide difference. Swales' method was compressed and entirely factual, and dry to read.[105] Taverner's method was fluid, responsive to people and ideas, more lively to read. During their stay they were eaten alive by mosquitos which prevented them getting much sleep, and the weather was very hot. Discussing the value of Point Pelee as an observation station in correspondence with Fleming Taverner wrote:

> "Yes Pelee would make a great station for a season's observations . . . I think that with a very little continuous work Point Pelee could be made as classical a ground as Helegoland almost . . . If I were a good talker I think I could get some of our wealthy men to finance some sustained work there. Think what a small amount of money would do there. Maybe the chance will come some day."[106]

Now we can take a critical look at the contents of the work. The first issue appeared in *The Wilson Bulletin* of June 1907 and consisted of a twelve page introduction and an annotated list of waterfowl. The authors gave credit in separate paragraphs to each member of the GLOC from whose notes the report was mostly compiled, as well as to Mr. Albert Gardner whose information on various birds they found reliable. His information on waterfowl was particularly valuable because it was difficult to gather waterfowl data on short and unsystematic visits.[107] A physical and ecological description of the area included information on vegetation, and a paragraph by A. B. Klugh on its Carolinian aspects. The importance of Point Pelee as a funnel for migration across Lake Erie was also discussed.[108] Taverner and Swales were fully aware that the list was based on relatively few visits. This was a preliminary survey, one that should be updated as more data could be collected.

The study is valuable because it provides a base line of information against which recent information on the birds of Point Pelee can be measured. It supplied information on bird distribution — what birds might be found on migration with some indication of abundance, approximate dates, and sometimes location. For instance Connecticut Warblers were seen in late May and early September. In September 1905 nine individuals were seen during the first ten days, while in the first three days of September 1906 Connecticut Warblers were almost common. "They haunted the damp tangle bordering the eastern beach near Gardner's and along the cross-road, and were still more frequently met with in the beds of jewelweed, closely adjoining, in the open spots of the woods. By remaining quiet in such places we were able to observe this interesting species at will."[109] Other species about which there is distributional information are Golden-winged Warbler; Northern Parula; Prairie Warbler; Louisiana Waterthrush; Bald Eagle; [Northern] Cardinal; Dickcissel; and Eastern Bluebird. The descriptions of the behaviour of several species are particularly vivid and show Taverner's powers of making a bird come to life through words. Some examples are: Sanderling; Piping Plover; Sharp-shinned Hawk to which four pages were allotted to describe its fall migration; Peregrine Falcon with a first hand description of one striking down two Blue Jays to the left and right in a flock; the carefully observed "song" of an Eastern Screech Owl; Ruby-throated Hummingbird's feeding characteristics; and Lincoln's Sparrow's elusiveness. The most impressive display of Taverner's word painting was devoted to the fall migration flight of Purple Martins at the Point in 1907.[110]

The final part of the Pelee list appeared in the September 1908 issue of *The Wilson Bulletin* and

contained considerable additional information. Short visits in 1908 at the beginning of May and in mid-August added further knowledge especially about migration. The authors were tempted to generalize about the "wave-like" formations of many of the migrations. Birds that are not normally regarded as gregarious came together at times in such numbers as to constitute a wave and were drawn together not by any community of interest. Rather their gatherings were the result of each individual, acting in response to common conditions, making for the same crossing place of the lake and arriving simultaneously. Such "waves" or "flights" were recorded in the list and dates of these were summarized at this point. For example: Sharp-shinned Hawk — 1905, 10-17 September; 1906, 15-22 September.

Reactions to the completed study were muted, probably because its publication had taken place in five issues of a journal extending over a period of fifteen months. Presumably the reason why Lynds Jones, the editor of *The Wilson Bulletin* accepted the study and allowed it so much space was that his own research was closely involved with bird migration through Point Pelee, and the journal he edited was mainly focused on the northeastern United States. To make a real impact it would have been much better if such a substantial study (76 pages) could have been published as a booklet. Taverner and Swales were aware of this and arranged to have a number of copies bound together with strong paper for presentation to some of the more important ornithologists and for the exchange of separates with other authors.

However, it received a favourable, short review in *The Auk* by J. A. Allen, who said, among other things, that the physical and biotic conditions of the locality were described in detail, followed by an extensively annotated list of 209 species identified as occurring in this limited area. Supplementary notes followed, including comments on hypothetical migration routes. The only other review it received was in the *Windsor Record Daily* (evening edition) of 27 February 1909, under the headline: "Birds of Point Pelee: most interesting Ornithological Centre in Canada."

One friendly but firm critic of the work was J. H. Fleming. Writing to Taverner early in 1909 he mentioned that there were several things he had wanted to talk over with him.

> "One was your recent literary efforts in which I noticed a lapse that you ought to check before you get into the habit of writing like a Sunday special. I am anxious you should keep to your good old style."[111]

To which Taverner replied:

> "Your criticism on my new style is severe. I was unaware of my lapse. Do you refer to the Wilson Bull. stuff? I thought I had avoided mushiness though making it light for general interest. Will have to watch out in the future."[112]

Whatever criticisms can be made of his first major piece of ornithological writing, such as the fiction that a bird has a "personality", one thing stands out. Taverner had an extremely observant eye, a remarkable ability to concentrate on a single bird or flock of birds that he was observing and to describe it vividly. With a draftsman's sense of form and movement he had the ability to transform personal impressions into word pictures informed with feeling. Above all Taverner loved birds — their calls, songs, movements and their intricate and beautiful plumage. He used a sensitive prose in order to transform what he experienced so warmly himself into sharp images so that others might share these experiences with him. The adoption of an anthropomorphic viewpoint from time to time was used by other naturalists in this period — Ernest Thompson Seton was an outstanding example — and was a way of communicating with a reading public which felt at ease with such terms.

Early in 1906 Fleming was working on an annotated list of birds known to have occurred in the Toronto area. No such list had been compiled before and it posed a number of problems, outstanding among which was the status of the Trumpeter Swan in southern Ontario. There are two species of swan native to North America; the Trumpeter and the Tundra* but it is difficult to distinguish between them with certainty. Size, weight, shape of bill and position of nostrils, the presence of a yellow spot in front of the eye in the Tundra but not in the Trumpeter are indications of species, but are not conclusive evidence. Positive identification of these two swans is provided by differences in convolutions of the windpipe in the breast bone. In the Trumpeter Swan the windpipe makes a high vertical loop over a bony hump in the sternum, while in the Tundra Swan this loop is absent.[113] At the time of which we are writing these distinguishing marks were known but few ornithologists had any first hand experience with Trumpeter Swans either as preserved specimens, or as living birds, because of their extreme scarcity.[114] Fleming and Taverner each spent many hundreds of hours searching the literature, checking old skins and examining the sterna of recently killed swans, not to mention writing to each other. The search for genuine Trumpeter Swans became an obsession for both men — something of a "wild swan chase". Taverner was optimistic enough to consider that specimens of Trumpeters might still be found, and set out to examine recently killed swans. His experience in taxidermy and in making drawings on linen (blue prints) as a draftsman now came in very useful. When he started he had little knowledge of swans, only a strong urge to prove the identification scientifically of each bird he examined.

*Formerly called the Whistling Swan.

Five members of the Great Lakes Ornithological Club at club's "shack" near the end of Point Pelee, 3 October 1909. Left to right: J. S. Wallace, B. H. Swales, W. E. Saunders, J. H. Fleming, P. A. Taverner (seated on steps). (Reproduced courtesy of the Canadian Museum of Nature, number 60386.)

After two years of searching the two men had made some progress but realized that they would have to make a major breakthrough if they were to write a satisfactory study of the swans. Fleming put his hope in finding a specimen of a Trumpeter in a private collection while Taverner pinned his faith in collecting a lot more sterna. By a stroke of luck for Taverner this is just what happened. On March 15th 1908, on a misty morning with a wind blowing downstream, the water below the Niagara Falls on the Canadian side was suddenly full of struggling swans. At least 125 birds were dragged out of the water while many more were swept downstream.[115]

Eventually Fleming secured thirty-three swans which were taken to Oliver Spanner's taxidermy shop in Toronto. A series of measurements were made including weights, and Taverner took drawings of all the variations in the beaks. Taverner included in his Journal for this period a short note on each bird to add to his growing collection of swan data.[116] When they had all been skinned not one of the thirty-three dead birds was found to be a Trumpeter Swan.

Fleming and Taverner had devoted a considerable amount of time over a period of nearly three years to a comparison of the two swans native to North America. In the end Fleming discovered a hitherto unknown specimen of a proven Trumpeter Swan in Toronto which eventually was added to his collection, and is now preserved in the form of a skin in the Department of Ornithology at the Royal Ontario Museum.[117] Taverner developed skill in drawing soft parts of birds and their bills. The experience he gained with Tundra Swans was useful to him in future years.

Although Taverner had got the worst in his correspondence with J. A. Allen over the revision of the AOU Check-list he was too stubborn to give up the struggle. An editorial by J. Grinnell in the *Condor* in 1906 on "Better Vernacular Names" spurred him to try again.[118] This time he was on slightly firmer ground because he and Swales were working on their annotated list of the birds of Point Pelee and were frustrated by problems of nomenclature they encountered. They blamed these difficulties on the AOU Check-list for what they claimed were too many ill-considered changes. Taverner sent Grinnell an article suggesting reforms that he felt should be incorporated in the revised Check-list which was being prepared. His article was published in 1907.[119] Since it contained specific suggestions which were "in the

air" at this time it called for an answer. This task fell to a member of the AOU committee for the revision of the Check-list, Witmer Stone, who wrote giving various reasons why Taverner's suggestions, which had been considered by the committee in the past, had not been adopted. Most members agreed that the system needed improving but they were unable to agree on what should be done.[120] This was of no help to Swales and Taverner who had to wrestle with problems of nomenclature in their attempts to maintain uniformity in their own list of the birds of Point Pelee.

Taverner was now thirty-two years old, very much a local man who had not yet made his mark and was still not a member of the AOU, only an associate. He was lacking in knowledge of what had already been proposed and discussed as regards Check-list revisions, and he was lacking in tact. He was rather like an immature eagle standing on the edge of the nest, flapping its wings vigorously, impatient to fly, but not yet able to take to the air.

Amateur ornithologists may not have the laboratory training and equipment, nor the status in the world of professional ornithologists to contribute much to nomenclature. But they can and do amass valuable collections of data in their own area when they keep records regularly and methodically over a number of years. The activities of the GLOC stimulated some of its members to keep systematic records, and to discuss in the Club Bulletin the status and distribution of various species in the southwestern region of the Great Lakes. For instance useful records were kept during the six-year period 1905 through 1910 by Fleming in Toronto, Saunders in London, and by Swales and Taverner in Detroit and vicinity. Also the records of the GLOC kept for sightings at Point Pelee represented the joint efforts of its members.[121]

Taverner's own records were systematic and extensive. His manuscript Journal (in typescript from 1906 through 1910) contained descriptions of visits to Pelee and various places in and around Detroit. The Journal gives a very readable account of his activities, ideas and projects during these years. In addition he kept a list of first arrivals in southeastern Michigan and southernmost Ontario for 1907 and 1908; and a record of fall migration in the same area for 1907 with birds seen at Point Pelee marked with a P. He also kept eight volumes of "Notes and clippings about birds" by species. These were typed and dated; some gave a note of the place where a bird was seen or collected, and a reference to where information was published when relevant. The carbon copy of his Journal he cut up and pasted into his "Notes and Clippings" books.[122] In this way he had information on individual species quickly available, not only from his own records but also from other sources.

Point Pelee, as an exciting place for field studies by naturalists, received publicity for the first time when a Detroit newspaper printed an illustrated feature article in its Sunday Magazine section in 1909. At the end of May Taverner had gone to Pelee with two friends from Detroit — Dr. William Newcomb whose special interest was in butterflies and moths and Bryant Walker, an attorney, whose hobby was the study of shells. The *News Tribune* sent a reporter and a photographer to interview them enjoying their recreation. Taverner noted in his Journal:

> "About ten o'clock a rig drove up with a delegation from the Detroit News Tribune composed of a reporter and a photographer. We posed for them and told them all the stories that we could think of. They left about one o'clock."[123]

Writing to Fleming in June he told him:

> "I took Dr. Newcomb lepidopterist and Mr. Walker conchologist with me to the Point and they enjoyed it very much. Monday 31st we were visited by the representatives of the Sunday Detroit Paper who photographed and questioned us to their hearts content. Guess they are going to give us a big splash. I have copies of all the pictures they took and they are very amusing and interesting to us as they show us in all phases of our field work both inside and out of camp."[124]

The title of the article "The Birds' Jumping Off Place" came from Taverner. The same phrase was used by him in his Journal of September in 1905.[125] The Detroit newspaper article contains much that is straight from Taverner and can be traced to his Journal, with some contributions from Newcomb and Walker. The reporter, Henry Richmond, explained correctly the significance of Point Pelee for seasonal migration, and the part being played by the members of the GLOC in studying how it took place. He also explained why naturalists came regularly to Pelee.

> "So attractive was this jumping-off-place of the birds found to be, that a number of years ago five naturalists established a club house there and began to make periodic visits to the point for the purpose of collecting specimens, studying the habits of birds and comparing notes. These men are P. A. Taverner, of Detroit; B. H. Swales, of Grosse Island; J. H. Fleming of Toronto; W. E. Saunders, of London, Ont., and James S. Wallace, of Toronto. All these men are enthusiastic bird students and the results of their researches have added much important matter to the literature of their science.
>
> These men pursue their scientific hobby as a mere matter of recreation and without a thought of making it contribute to their livelihood. They are bird lovers who seek every opportunity of slipping away from the prosaic routine of life to catch an esthetic uplift from a glimpse of the freedom of the air and the tree tops. And so it happens that once or twice each month the week-end or a holiday finds one or more of them at the little club house half-way down Point Pelee, picking up scattering [sic] bird records and revelling in the delights of the out-of-doors."[126]

The article is filled with sound information but told in a lively enough style to interest Sunday

readers in the city. A fair part of it is quoted directly from Taverner's own descriptions — of humming-birds feeding on jewelweed and then setting out to cross the lake, or the vocal courtship of a pair of Eastern Screech Owls. At the end of the day "each man has his story to tell as they gather around the long deal table in the little club house at night and make up the notes of the day."

The photographs are good and are a valuable source of evidence of what the shack looked like, and the three men interviewed, as well as their equipment. Also included in the article are two sketch maps, one of which shows Point Pelee, Pelee Island, Kelly's Island, and Marblehead, Cedar Point and Sandusky in Ohio. All in all this was an ambitious attempt to explain to non-specialist readers why so many birds use Point Pelee for the spring and fall migration.

Taverner's interests in natural history had always been wide and he would sometimes collect creatures other than birds to show to acquaintances knowledgeable about mammals, reptiles or insects. One day when birding in Detroit he and Swales met a man collecting insects whose name was Arthur Andrews.[127] As a result Taverner's alert mind became interested in moths and butterflies, and his Journal for 1908 and 1909 mentions collecting moths at night near his home, as well as at Point Pelee. Through Andrews Taverner met a few other amateur naturalists including William Newcomb and Bryant Walker. A club was started which provided Taverner with a fresh outlet for his energies. As he explained to Fleming it consisted of five members. "We meet very informally at each other's houses and have no organization, officers or anything else. We just meet and chat as the spirit moves us. Optimistically Percy continued "We are instituting a general biological survey of S. E. Mich. territory, each in our several lines .... All are good serious workers and no dilettante need apply."[128] The sight of monarch butterflies massed on the trees at Point Pelee in the early fall excited Taverner's naturalist instincts and he wanted to know why they were there at that time in those numbers. Since no one appeared to have written on this phenomenon at Pelee he wrote a note himself and sent it to the *Entomological News*. It was a detailed description of what he saw on visits in three consecutive Septembers. He concluded by saying that whether the monarchs were all migrating in the true sense of the word or not, he left to the entomologists to decide.[129]

Although Taverner was very careful not to put forward any hypothesis in this note he showed what he had in mind when writing to Fleming.

> "Am glad you liked the butterfly paper. I thought it was worth while. It is an example of the danger of too close clinging to one line of work. We bird men are too apt to discount instinct and believe nothing than cannot be explained by experience, example or acquired knowledge. Yet here are these butterflies shewing all the phenomena that we are accustomed to explain by memory and example that have certainly never travelled the road before ... I have often thought that in nature the seasonal changes are to a certain extent automatic and that there is a strong tendency towards the reoccurence when certain dates are reached irrespective of the weather conditions. In other words, the seasons tend to run by calendar."[130]

Taverner had no laboratory in which to conduct experiments with birds at migration time, no university to back him with the necessary funds. His insight that seasonal changes in birds tend to keep more to the calendar than to weather conditions might, under more congenial circumstances, have led him to examine the effects of the lengthening and shortening of the days, in other words of the effects of light, on the bird's biological mechanism.

Another problem of migration interested Taverner at this time. When he was living at Port Huron in the period 1899-1902 he found a fair number of Saw-whet Owls each fall which made him wonder if this was simply a local movement at the end of the breeding season, or a larger-scale migration. However, when Saunders reported the migration disaster that occurred on the shores of Lake Huron north of Sarnia in mid-October 1906 and he found twenty-four Saw-whet Owls drowned, Taverner noted in his Journal that it proved this little owl was a migrant. However, further proof was required before it could be established as a fact beyond doubt, and what better place for such a record than at the tip of Point Pelee. On the weekend of 14-16 October 1910 Saunders, Taverner, Swales and Wallace were bird collecting at the Point and saw several Long-eared Owls in the red cedars. Two were shot for specimens and the contents of their stomachs examined. One contained feathers of a Saw-whet Owl. Taverner and Swales started searching for Saw-whet Owls and found ten in the cedars perched close to the trunks, and six feet from the ground.

At this point Taverner returned to camp to collect his camera which was a substantial one with a bellows and mounted on a wooden tripod. He went back to where Swales had one Saw-whet under observation. Because the bird was too high to photograph with only the existing tripod Taverner improvised additional legs which he spliced onto the original ones. The result was rickety but it enabled him to raise the camera lens above most of the leaves and twigs. By standing on tiptoe he was just able to focus the camera, and stopping down to about US 64 he took a six-second exposure. Swales tried to see how close it was possible to get to the bird when it flew, but only a few feet away, and alighted in an excellent spot for photography. The additional legs were hurriedly refastened and the camera set up again at a much closer range, as Taverner noted in his Journal:

"... in fact the bird was as large on the ground glass as the length of the bellows would allow me to focus. I stopped down to U.S. 128 and as the bird was in the sun gave it another six second exposure."[131]

Eventually an account of this episode by Taverner and Swales appeared in *The Auk*. The final paragraph of the article summarized their conclusions.

"Here, then, are records of four migrational massings of this hitherto supposed resident owl. It was too early in the season to explain their gathering as 'winter wandering in search of food', and the close tallying of all the dates point to the conclusion that from the middle to the end of October the Saw-whet Owls migrate in considerable numbers, but from their nocturnal habits and secluded habitats while en route are seldom observed. In all probability, too, such noticeable gatherings are only to be observed in such places as at Point Pelee where a constricted migration route brings many together at one time. Long Point is another place much like Pelee in this regard, and the Lake Huron episodes likely originated in other fly lines across that body of water and of which we as yet know nothing.[132]

The photograph taken in good light was remarkably successful considering the difficulties. Taverner was so pleased with the result that he printed copies on postcards and sent them to his friends.

By now Taverner was a reasonably skilled photographer. He was also a skilled enough draftsman to make bird illustrations and line drawings for the book on birds of Michigan which Walter Barrows had been writing for so long. Writing to Fleming in January 1910 he said that he was working on a lot of heads and legs for Barrow's Bulletin. In the same letter he mentioned that he had recently collected together all his old bird pictures and was mounting them on heavy brown paper and classifying them into a portfolio, and was surprised at finding he had so much good material.[133]

Barrows' *Michigan Bird Life* was published in 1912. In the preface he acknowledged Taverner's contributions.

"To Mr. P. A. Taverner I am indebted not only for hundreds of field notes on Michigan birds, but for the original drawings or actual electro-types from which thirteen of the full page plates and fifty-eight of the text figures have been made, the latter including almost all the detail[ed] drawings of head, bills, wings, feet and tails used in the Keys and elsewhere."[134]

The book ran to 757 pages of text. Taverner was in good company as regards illustrators; Ernest Thompson Seton and Louis Agassiz Fuertes were the main contributors, with Frank M. Chapman supplying a number of bird photographs. Taverner supplied wash drawings for American Bittern, Sora, and Hudsonian Curlew [Whimbrel] among others. The list of pen and ink drawings is formidable. Percy was modest about his ability as a bird illustrator, while Barrows said that his prices were too modest. He received $10.00 a piece for the wash drawings. Taverner told Barrows about the Saw-whet Owls at Point Pelee who envied him the experience but used a photo of a Saw-whet taken by Frank Chapman which looks as if it was of a dead bird posed on a tree stump. He would have shown a much more life-like photo if he had chosen Taverner's.

If Percy was ever to become well enough known to obtain a position in a museum of natural history it was important that as many of his ornithological records as possible should be accepted and published. Publication of his records in "Birds of Point Pelee" and *Michigan Bird Life* was useful as a beginning but from the perspective of obtaining a post at the museum, nearly completed in Ottawa, it was desirable to have his Muskoka and Pelee records published in the revised edition of Macoun's *Catalogue of Canadian Birds* (1909). Because his contributions to the first edition had not been directly acknowledged he had taken every occasion to send subsequent records to James Macoun, responsible for revising his father's work. Taverner was especially careful to send separates of his notes and articles in *The Auk* and *The Wilson Bulletin*, as well as to remind him of their previous correspondence about his records.[135] But when a copy of the revised edition arrived it caused him a sickening disappointment. In spite of all the care he had taken to send separates to James Macoun the new edition contained no references to Pelee at all and about half of his records published in *The Auk* were omitted. Taverner wrote immediately to James Macoun asking why he had not used the Pelee material. The answer he gave was very lame, as Taverner explained to Fleming. That the manuscript material had been passed to him in the summer of 1908 with instructions from R. W. Brock to hurry with the editing. (Brock was preparing for the opening of the Victoria Memorial Museum in 1911 and presumably wanted a new publication to impress the politicians.) That he was under great pressure from his own botanical work; that the separates were overlooked, that although copies of *The Wilson Bulletin* (containing "The Birds of Point Pelee") were received for some reason they were not consulted. That Macoun was sorry that these oversights had occurred but he would make it right in an addendum later.[136] It was not only James Macoun's lame excuses but even more the offhand tone of his letter that hurt Taverner's self-esteem when he wrote:

"The oversight in the whole matter was probably due to the fact that I was using Saunders' and Fleming's notes for Ontario and quite forgot your list, although I remember now that reprints were sent me."[137]

This provoked Taverner into sending a sharp note in reply. He was upset, he said, to find that what work he had done in the Dominion was so easily overlooked, especially when he had taken particular trouble to keep Macoun's department informed. The fact that even the notes in *The Auk* were not included gave it the appearance of a personal slight. He under-

Photograph of Northern Saw-whet Owl taken by Taverner at Point Pelee 15 October 1910. Taverner's account of the difficulties of photographing it is given in Chapter 4. (Reproduced courtesy of the Canadian Museum of Nature, number 31879).

stood the difficulty of covering such a vast territory especially when much of the work had to be through the reports of people not directly involved in zoology but a number of unfortunate errors and omissions would have been avoided if some Canadian ornithologists had been consulted on matters relating to their particular spheres of work.[138] Taverner had made his point and shown that although he was not well known to the Macouns, while Fleming and Saunders certainly were, nevertheless he was a serious ornithologist whose records could not lightly be overlooked. He had learned to stand up for himself through this experience, though at the risk of displeasing the Macouns.

After the excitement of discovering the migrating Saw-whet Owls in October 1910 Taverner's Journal began to peter out, the last entry being in November. The Journal had been the constant recipient of his ornithological notes and observations from the time of his arrival in Detroit in the spring of 1904. It contained not only data on numbers of birds and their distribution but above all descriptions of what it was like to be in the field and seeing, hearing and enjoying the scene. Out of many descriptions of bird observations at Point Pelee one will have to suffice.

> "I certainly never did hear so many birds singing in the winter as we did during this visit. When we opened the door in the morning we were greeted by a regular chorus of bird music. The most conspicuous were the [Northern] Cardinal and Carolina Wren calls which answered each other back and forth across the jungle. Next to them came the simultaneous warbling of dozens of Purple Finches and under them all was a low subdued tone composed of the combined twitterings of hundreds of [Common] Redpolls and [American] Tree Sparrows, the latter continually essaying their sharp little song. Altogether from aural evidence it was more like May than Feb."[139]

Exactly ten years later, after reading this description in his own Journal, he was moved to write to Bradshaw Swales:

> "Dear Brad; Do you remember blank years ago today the chorus of bird song we heard as we threw open the shack doors at Point Pelee in the morning?'[140]

There is more than a touch of nostalgia in re-living those feelings of a moment in time.

Not only did Taverner's Journal peter out during 1910 but the Bulletin of the GLOC also began to fail. Its few members were too busy with more important things. With the active support of Fleming and Saunders there was the chance that Taverner might obtain an appointment at the newly established Victoria Memorial Museum in Ottawa. (See Chapter 5.)

By early 1907 the Taverner family was settled into their own house at Highland Park, and during the next four years home life became more enjoyable for them. Where they lived was just beyond the western edge of the expanding city, and was still in partial countryside. The electric street car ran close by at Woodward Avenue so they could easily get into downtown Detroit and back. By 1908 they had a telephone. At the rear of the house was a section of field which Percy and his mother developed into a garden with advice from Fleming, based on his own gardening experience in Toronto, and a great deal of hard manual labour by Percy. Fleming and Saunders sent gifts of shrubs and plants during the next few years while Percy helped himself regularly to wild plants growing in the vicinity. From now onwards gardening was to take up a certain amount of his spare time. Although he had to work at the office on Saturday mornings he was able to do gardening in the afternoon and still go birding on Sundays.

Taverner's newly discovered pleasure in gardening led him to an interest in botany, and he happened to meet a few Detroit natural scientists who were not ornithologists but glad to meet Taverner. Informal meetings were held at each other's houses when scientific discussions developed.[141] Taverner also found expeditions with two or three members of this small group very congenial. For instance on Sunday, 15 May 1910 he made an exploring trip with two others, Newcomb and Andrews. In a letter to Fleming he wrote:

> "We found a fine Canadian island set down in Oakland Co. Pines, balsams, arbutus and the best sphagnum bog I ever saw, covered with cranberries, pitcher plants, cypripediums [lady slippers], swamp laurel and kindred stuff … Though I got no birds I enjoyed the changed conditions greatly."[142]

From 1909 onwards he mentioned in his Journal that he was collecting far fewer bird specimens, but instead his interests had expanded so that he wanted to learn more about birds in relation to their habitat. That is one reason why he began to enjoy the company of specialists in other aspects of natural science. There was much he could learn from them.

His outlook on taking bird specimens for his private collection was beginning to change at this time. If he relied on a shotgun less, then he would have to rely on a better pair of field glasses. Fleming had written several times about much improved makes.

Taverner took up the topic in 1909 when he wrote:

> " … I am just negotiating with Wallace who can get the finest Zeiss glasses I ever saw very cheap — $35.00 through friends from the Old Country. They are prism glasses of course and the largest and brightest field I have seen. I feel every day that I need a good pair more and more, especially as my collection of commoner stuff is getting filled up and I hesitate to shoot more of them."[143]

In spite of having a slightly weakened heart as a result of having typhoid fever while in Chicago , and therefore not being free to play strenuous sports, he was in good health. He seemed to have kept fit on a routine of continual work, and outdoor exercise walking. He certainly did not coddle himself. He took it for granted that he could carry equipment such as a gun, heavy camera, binoculars and collecting bag all day without difficulty. He seems to have

felt satisfaction from the challenge of physical endurance.

During his local birding he could not fail to notice the effects of housing development on the former countryside. Two entries from his Journal show that he was aware of the problem of conservation. One day he and Swales went to the Mud Flats and then continued by way of the usually productive "warbler woods".

"Alas poor warbler woods, nothing remains of it but piles of brush and great lines and stacks of cord wood. It was a sad sight to me and a worse one to Swales who remembers it when it was far vaster than ever I saw it."[144]

Another time, while walking in the vicinity of Hamilton Boulevard, he found a good patch of hard wood, the kind that makes an excellent warbler woodland. "But alas it is about gone just as it is found. The lumbermen have been at it all winter and it is almost in ruins."[145]

One ingredient seemed to be missing from the home life of a man now turned thirty-five — there was no suggestion that Percy had any girl friends — no indication of any love interest or sex life. This may be due to his natural reticence and the fact that no records of a personal nature appear to have survived. When he died in 1947 his long-time friend W. L. McAtee was invited to write an *In Memoriam* notice for *The Auk*. For information on Taverner's earlier years McAtee turned to the one person still alive then who could supply it — Percy's half sister Ida. But although she mentioned their life in Detroit the information she gave was mainly about wildlife and there was no mention of Percy in relation to the opposite sex. What his sister did mention was "his wonderful care of mother and me". Percy may not have felt confident enough to have a close relationship with any other woman partly because of his stammer which was always worse just when he wanted to speak fluently. Several "schools for stammerers" in Detroit advertised their courses in the City Directories of this period, and one claimed that stammerers could be permanently cured. When he first came to Detroit in 1904 Percy had taken a course which he hoped would be a more or less complete cure. As he perceptively wrote to Fleming:

"Stammering has been so long a part of me that I would not recognize myself without it, and a cure is hard to believe as possible."[146]

He certainly was not cured by 1910. Another reason may have been because of his personal appearance. He was over six feet tall with a dark beard and side-whiskers which gave his face a slightly elongated effect. Already in the club photo of 1909 his hair was beginning to recede from the top of his head.

With so much of Taverner's energy being taken up by his various natural history interests and activities it is difficult to think of him in his job earning his living as an architectural draftsman. When we last heard of his work as a draftsman he was resigned to continuing it as long as necessary, but he never expected that he would become an architect, and make a success of his profession. On the other hand this was not a routine job which called for no thought and little skill. He had to be able to transform the sketches and notes of an architect into a series of "blueprints" drawn exactly to scale. This left him room for some expression of originality though not much. He was trained, capable and, by this time, experienced in this work which required accuracy, patience and an ability to draw. Work in the architectural business in Detroit during these years fluctuated between lay offs, part time or full employment and even overtime. It was also possible to quit a job with one firm (or be made redundant) and to find a job with another firm without too long an interval. Taverner continued working for W. E. N. Hunter, until March 1909 when he was employed by the firm of Baxter and Odell. Taverner was pleased with the new job and, as he explained to Fleming, relations with his employer were pleasant. He was very glad that he made the change. It had been so long since he had received common courtesy in the draughting room that it was quite a change.[147] By 1911 Detroit was a growing city with a flourishing economy. Thanks to Henry Ford and others it had now become the automobile capital of the USA. Its population had grown from 285 000 in 1900 to 466 000 in 1910. Transportation was good — by train, interurban electric cars, and by local street cars. The city was pushing out its boundaries, and architecturally was a challenging mixture of styles, including some of the early "sky scraper" buildings. Entertainment, both popular and cultural, was growing fast as were opportunities for sport and recreation in Detroit and vicinity. But being an architectural draftsman was not Taverner's first choice for a career. He could make a living out of it but he could never consider making it his permanent career. He compensated for his lack of commitment to his office work by an absolute commitment to the study of natural history. Only this could satisfy his deepest feelings.

In the summer of 1910 Taverner reached his thirty-fifth year. By now the main traits of his character were established and he had developed sufficient self-knowledge to understand himself and his limitations. To understand him it is necessary to see him as a complex person who had managed to adapt successfully to a complicated situation. He was a compulsive worker who needed to be fully engaged and if he did odd jobs for any length of time felt ill at ease. In a letter to Fleming in 1907 he wrote that he did not know what had been the matter with him in the last while. He had been unable to concentrate upon anything. He thought that he had too many matters on his mind. Nothing of any consequence

but various odd jobs, including a little lepidoptera work about the electric lights, had been another distraction.[148] Although there was "nothing of any consequence" on his mind, subconsciously there could have been something of deeper significance such as the urge to find himself a mate or the utter incompatibility of combining the work of a draftsman with the work of an ornithologist. How he was able to combine the two types of occupation without becoming schizophrenic in these years is a mystery. It showed a considerable resilience on Taverner's part to continue doing both adequately. It showed an iron determination to continue both. His ambition was to become a "scientific" ornithologist and to gain some recognition for his work in this field. He drove himself hard in trying to achieve his ambition and seems to have indulged in few relaxations. He smoked a pipe regularly and found it soothing.

Taverner thought seriously about the creation of the natural world and the place of human beings in it. Fleming asked him in a letter if he had ever read Darwin's Journal and he replied that he had a copy of it, and that it was a book he thoroughly enjoyed reading over and over again.[149] Fleming also sent him two articles, one of which was an interview by someone with Thomas Edison.[150] Taverner responded by sending Fleming his views, and revealing something of his own thinking about religion and his critical, independent cast of mind. At the end of his long letter to Fleming on science and religion Taverner summed up what he believed. "My whole religion is this. I know nothing. I surmise a few things."[151]

In 1908 Taverner, as he told Fleming in a letter, was in the process of becoming a Freemason. This was rather a financial strain on him too. Soon afterward he had a formal photograph taken, dressed for a ceremonial occasion, which his friends said made him look "very good". But Taverner hoped that he did not look quite as weakly goody-good as he thought it.[152]

There is no evidence that he went to church services of any religious body. His outlook on life, which he had already arrived at, had been reached by reading, and by his close experience of the natural world. Although not "religious" in the usual human use of the term he felt a sense of mystery about the complex interactions of the universe of which the human species was a part. Taverner was an observer and thinker who wanted to come to an understanding of life and its purpose through his own reasoning rather than to accept ready-made explanations handed down by authority. The whole direction in which his philosophy of life had been developing during the past ten years was against accepting anything on faith just because someone stated that something was so. He had a questioning nature. But this was not through any idea of his own intellectual superiority or claim to leadership. The opposite is true. He realized that his lack of formal training in biology put him at a disadvantage in natural science. He knew himself well enough to realize that he had no aptitude to organize others or to become a leader.[153] Nor did he possess much self-confidence in his relations with other people at this time. He knew almost nothing about his own father, and to have to gloss over the fact that the name he used was not his name at birth, must have caused some psychological strain.

The "A" of his given names caused him uneasiness while Percy fitted him comfortably enough. The secret was out in 1907 when the AOU requested all its members to write their given names in full so as to include them in full in the membership list. When Fleming received this request he told Taverner that he had sent his own, James Henry, and asked what his were.[154] Taverner replied: "As to names I do not advertise mine — Algernon is not one to be proud of."[155] Apparently Percy did not reply to repeated requests from the AOU Secretary, T. S. Palmer, who finally sent him a letter warning "If you do not reply I shall list you as Percy Algernon Taverner."[156] To this Taverner replied: "Guilty as charged".[157]

Taverner had a naturally unassuming nature as well as a strong sense of humour, of comic events or absurd situations. He was not in the slightest pompous. He did not regard himself, even in his ornithological work, so seriously that he could not make jokes at his own expense. The most outstanding qualities in his personality were his friendly nature and his streak of stubbornness. This is the kind of man that Taverner appears to have become by the age of thirty-four.

## CHAPTER 5. From Amateur to Professional

Although Taverner may have pushed to the back of his mind any thoughts of obtaining a position at the new museum being completed in Ottawa in 1910 his friends had by no means given up hope of seeing him in the position of ornithologist there. As the time drew near for the transfer of the Geological Survey's collections to the museum building Taverner's future career was again on the block.

Much had happened as regards the Victoria Memorial Museum since 1906 when Taverner first heard about a possible position there. As the result of "An Act to create a Department of Mines" passed in 1907 an administrative reorganization took place by which a Mines Branch and a Geological Survey Branch were placed under a Department of Mines headed by a minister. The

Survey's duties remained virtually unchanged; it was still responsible for

> "examining and surveying the geological structure and mineralogy of the country…"

At the same time the Act maintained the Survey's relationship with the Museum.

> "The Department shall maintain a Museum of Geology and Natural History for the purpose of affording a complete and exact knowledge of the geology, mineralogy and mining resources of Canada."

In addition it was charged to

> "collect, classify and arrange for exhibition in the Victoria Memorial Museum such specimens as are necessary to afford a complete and exact knowledge of the geology, mineralogy, palaeontology, ethnology, and fauna and flora of Canada".[1]

The Victoria Memorial Museum was not founded as a new and comprehensive national museum but developed out of the geological museum maintained by the Geological Survey of Canada. The collection and display of natural history specimens was only a part of its functions.

As a result of the Act the Geological Survey was no longer a separate government department but was now one branch of a department of government alongside another branch (the Mines Branch).

> "It would have to compete with the other branch for a share of the departmental appropriations, and for the ear of the deputy minister and minister for decisions as to which program to pursue, and with what intensity."[2]

This would cause problems within the museum divisions in the future. In addition, the Director of the Geological Survey, Albert Peter Low, became seriously ill with cerebral meningitis at this time. As a result a professor of geology and petrology at Queen's University, Reginald Walter Brock, was named Acting Director of the Survey Branch at the end of 1907. When Low's condition worsened Brock was made Director of the Survey and Acting Deputy Minister of Mines in late 1908 at the age of thirty-four. Brock had joined the Survey in 1898 and had five years' field experience before going to Queen's as professor in 1902. He brought a dynamic quality to the Survey which was needed at this time of reorganization and museum development. He was fortunate that the Canadian economy had begun to revive so that the annual appropriations to the Geological Survey were adequate, and in turn were adequate for building up the natural history collections and appointing new staff. In 1907, C. H. Young, an entomologist with the Experimental Farms Service, was appointed assistant to the curator of the museum and prepared a series of display cases illustrating the life histories of butterflies and moths. William Spreadborough was employed in 1908 to make a collection of the natural life of Vancouver Island for display in the future museum.[3] In 1909, Jim Macoun edited a new one-volume edition of the *Catalogue of Canadian Birds*. Brock had instructed that the manuscript should be completed for publication quickly so that it would be ready before the disruption of the move into the Victoria Memorial Museum which was expected to take place in 1910. In his hurry to complete the job Macoun failed to correct many errors in the original catalogue completed in 1904, or to include much of the most recent field data supplied by correspondents such as Taverner.[4] Nevertheless, it was a useful foundation from which future distributional studies of the birds of Canada could begin. Brock, in his report as Director of the Survey for the year 1910, wrote optimistically about the future. "Now that the Victoria Museum is being occupied, every effort will be made to strengthen the staff." He was determined, he wrote, to make it "a complete natural history museum".[5] It was at this point that P. A. Taverner was considered for a position in the Natural History Department of the museum.

In March 1910, Ernest Thompson Seton was in Ottawa and heard through John Macoun that a position at the museum might become available. Macoun mentioned Taverner's name in that context. Seton called on Fleming in Toronto on his way home and relayed this information. Fleming immediately wrote to Macoun to ask if Taverner should go to Ottawa so that he could be seen. He then wrote to Percy with the news suggesting that he should come to Toronto over the Easter holiday, when special train rates were available, and then go to Ottawa, adding "I will be responsible for the cost of the trip." Fleming now had the bit between his teeth. He was excited by the prospect and anxious for his protegé not to let slip any opportunity to further his own chances. He warned that "… there may not be anything in it but one never knows and any way a meeting would be well worth while if we can arrange one. I told Macoun I did not know what was on your mind."[6] The scenario now became involved. James Macoun answered Fleming's letter to his father saying that "it would be quite useless for Taverner to come to Ottawa just now" and explained how they came to speak to Seton about Taverner.

> "When he was here two years ago he asked whether there would be an opening for one of his nephews, and either my father or I introduced him to Mr. Brock and I believe he made at least a verbal application to Mr. Brock at that time. When Seton was here Monday he brought the matter up again by telling us that his nephew was now in the Field Museum at Chicago and so would not be an applicant for any opening that there would be here."[7]

James Macoun explained that he asked Seton what he thought of Taverner, but that was all that had been said or done in the matter. Meanwhile, what Macoun wrote next put Taverner's appointment in an unsatisfactory light.

> "Neither my father nor I know anything at all about what new appointments will be made for the new museum, nor indeed do we know whether we would be consulted in the matter, but naturally we would both like to see the best available man appointed as taxidermist, and from

what we have been able to learn from yourself, Seton and others it seems that Taverner would be just the man. I may tell you at any rate that we know of no one else. It cannot be very long now before some action will be taken, and if either my father or I are consulted we will say that, so far as we know, Taverner is the only available man for the position of taxidermist."[8]

This was a curious mistake for James Macoun to make. It was made perfectly clear in 1906, when Taverner was being considered for a possible position at the future museum, that he would not have accepted the post of taxidermist. Perhaps James Macoun had forgotten this. However, this is not how Fleming and Taverner regarded it. Fleming sent Macoun's letter to Taverner to explain why his projected trip to Ottawa would be useless, and commented:

"I have been aware from some time that there is a cold hand somewhere and I fancy it is Jim Macoun's influence with his father. One of the things I did not do was to recommend you for taxidermist as Jim Macoun very well knows ...".[9]

The new Director of the Geological Survey, R. W. Brock, was not looking for a taxidermist at this time as the following extract from Fleming's same letter proves. A Toronto taxidermist, Horace Mitchell,[10] had seen Brock in Ottawa a few days previously to ask whether a position of taxidermist was likely to become vacant. Brock told Mitchell that there was unlikely to be any changes for a year, and did not give him much hope of a post.

"However he told Mitchell they were looking for a man for the position, I think, of Curator . . . and here is the joke, Brock mentioned Seton was the sort of man they would like. I must go to Ottawa and find out really what conditions are. I don't know Brock. But I fancy you will have to wait till some future date for anything definite. I don't believe they know what they want and I think Jim Macoun is afraid someone bigger than himself will get it. I am sorry to have stirred you up but Seton's statement was so straightforward that I naturally felt justified in writing to Macoun."[11]

Taverner tried to guess at the cause of James Macoun's attitude.

"Perhaps the antagonism of Jim Macoun may largely be due to my not carefully concealed opinion of the List. I think I told him that it was most creditable as a botanists attempt at ornithology but that it was rather to be regretted that an experienced ornithologist had not been further consulted as it progressed. It may not have been politic under the conditions but if the only way I can get a position of the kind is by truckling to others I think I will stay a draughtsman. However if I can get it without losing moral independence there is nothing I would like better as you know."[12]

At the same time Fleming wrote to James Macoun to say that he was mistaken in thinking that he, Fleming, had recommended Taverner for a position as a taxidermist.

"I stated that he had a thorough knowledge of the subject but that he would not accept such a position. The position I consider Taverner fitted for is curator of the natural history section of the museum that is to be, in fact he is just the man to carry out the views of the staff and work with them and stand between them and the public."[13]

Macoun's reply was a frank apology and an admission of the muddle prevailing in the Geological Survey over the Museum.

"It was pure thoughtlessness in writing to you as I did regarding Mr. Taverner as I of course knew the position for which you were recommending him, and we had no other in mind. The word taxidermist was a simple slip. So far as we can make out nothing at all is being done about appoi[n]tments and no[n]e of us know where we stand ourselves or what new appointments will be made . . . This of course is a bad state of affairs with the Museum so near completion, but I suppose the whole trouble is that no Director of the Museum has yet been appointed and there is no one in authority."[14]

When Percy told the household of Fleming's initial letter it caused "a lot of commotion".

"Mother and Ida would of course go with me if any such move were made but it would be like pulling a plant up by its roots for her to break her associations here now just as we have got so nicely established. The house and garden seem to have become part of her almost now and I must confess it would be rather a pang to me. However it would only mean beginning over again and we would soon be as much at home at Ottawa as we now are here."[15]

Percy, Ida and their mother had already made various moves together and presumably could put down roots again.

At this point Saunders added his influence in a letter to John Macoun stating the advantages of appointing Taverner to the museum staff.

"I am very strongly impressed, more so indeed than I can tell you, with the fitness of Percy A. Taverner, Highland Park, Mich., who is a Canadian, for a position in the Survey. Besides being a keen observer, an extra good Taxidermist, he has a very artistic temperament. He is a good artist and by profession Architect. I am sure it would be exceedingly difficult for you to find another man so well equipped to assist you in the particular work there, as he is. Moreover, he is well educated and his letters are well composed. You have perhaps seen some of his writings in the *Wilson Bulletins*, but for fear you may not, I will send you in a day or two, something from it which will show you how he writes. I do not know where you could find another man so good to assist you in installing the collection in its new quarters, and I hope you will give him very serious consideration indeed."[16]

This letter was answered by James Macoun who sent a non-committal reply.

"As regards Taverner, neither my father nor I know anything about him personally but both Seton and Fleming seem to think that he is a man whom we should have at the new museum and, though my father and I cannot do anything to forward his appointment, we have no one else in view ourselves and to that extent at least may be considered as indorsing his application."[17]

Fleming was sorry that Taverner's projected visit to Ottawa had been turned down, and told him ". . . it is high time you should get acquainted with Ottawa.

I am seriously handicapped by you not being known in Ottawa." After advising him to go on with his work he added: "I don't want to be meddling in your affairs but I would like to see you in some place where your work would have a permanent value."[18]

There was a break in the correspondence during the summer while John Macoun was collecting plants in Nova Scotia and Brock was visiting several museums of natural history in the United States. There he could see for himself how to organize a museum and how best to display natural history specimens for exhibition. The next development came in November 1910 while Thompson Seton was on a lecture tour which included Detroit. Taverner wrote to Seton inviting him to stay the night when in Detroit. Seton declined because he had to leave for Winnipeg the same evening after giving two lectures, but added: "I hope however I shall have a long talk with you about Ottawa etc."[19] In fact he was able to spare Taverner only a few minutes. In writing to Fleming, Taverner reported that Seton had recommended him to Brock for the position at the museum.

> "He outlined just such a position as you have. A bird man, not necessarily a taxidermist but a judge of taxidermy and capable of doing scientific museum work. Salary $1500 a year with a rapid advance to 2500. A Canadian would be preferred . . . It has occurred to me that perhaps it has not been mentioned that I am a Canadian and some of the hesitancy may have been caused by the idea that I am an American."

Seton advised Taverner to write to Brock himself and ended the conversation by saying the position was his if he cared to go after it.[20] Whether or not Seton rubbed Taverner up the wrong way by being a little patronizing, Taverner was sharply critical of Seton when mentioning his visit to Fleming:

> "I was disappointed in Seton's lecture on his northern trip. His undoubted genius is so overlapped by an exalted ego. With the exception of one other listener I think the whole audience went away with the idea that Preble was but a hired guide in whom he had perfect confidence and a very good fellow for his station."[21]

Taverner now wrote to Brock asking for details of the post, mentioning that he was a Canadian citizen, and asking whether applications would be considered. Brock replied that it was likely that there would be an opening "for a Naturalist and Preparator in the immediate future."

What was wanted, he said,

> "... is some one who is fond of birds and animals, knows something about them and their habits, and who is something of an artist so that he could have specimens collected, mounted in a natural position with natural surroundings and exhibit them tastefully in the Museum. In addition to these rather rare qualifications if he could also write well it would be a further recommendation. In accordance with the Civil Service regulations the position will be advertised and applications received. Some testimonials as regarding work and samples and specimens of the work done would be helpful."[22]

Taverner sent Brock's letter to Fleming and commented:

> "This looks as though something is doing at any rate. I wonder if there will be a Civil Service examination attached. If so a language requirement would be fatal. The letter speaks of a Naturalist and Preparator. Seton said that a taxidermist was not the requirement but a critic of taxidermy."[23]

Fleming, who was aware of various "under currents" in regard to the appointment decided to go to Ottawa "to find out just which way the wind blows".[24] Before leaving for Ottawa to lobby for Taverner he wrote:

> "I guess any Civil Service examination will be a farce. Of course I don't know. You are independent and I would not take the ground of seeking the position, it is the other way about, at least we will try to make them think so."[25]

Fleming had the instincts of an accomplished lobbyist.

Suddenly the pace quickened. In a slightly dramatic gesture Fleming sent a night lettergram from Ottawa.

> "Have talked matter over with Brock. Showed my letter to Low of four years ago favourably received and Brock's description of position fits in nicely. Saunders has already written. I am to write too formally. Don't think position is immediate. Macoun is favourable. Can only wait for things to move."[26]

Like a journalist with good copy Fleming made the best of it and sent Taverner a four-page letter describing the interview with Brock and a talk with Macoun. He had over an hour's talk with Brock.

> "He is a young man with a determined face. I should say a born director of men. I showed him my letters to Low of four years ago and he said that is exactly what we want . . . After a little careful guiding I got him to describe the position I wanted, outlined in much my own words . . . Brock said we cannot afford to ignore the public after all it is their museum and we have no one to take the preparing of exhibits off our hands . . . I showed him the Swan drawings, he was delighted."[27]

Fleming then had a session with Macoun who told him some of the administrative and political problems facing the new museum; its role vis-a-vis the Geological Survey and Department of Mines, and the fact it might be placed under the Minister of Agriculture in the future, among other uncertainties. While they were talking Thompson Seton came into the room and three of them discussed Taverner's suitability for the position. According to Fleming

> "Macoun got enthusiastic and told us he himself would go to Brock and tell him Taverner was his choice. Seton said you could do anything but lecture. He gave you all sorts of a character enough to turn your ego into a dirigible had you heard it."

He also said that Seton knew Fisher, the Minister of Agriculture, and would write to him if necessary.

Fleming wrote:

> "Seton has done a great deal to prepare the ground and Saunders, Brock tells me, has written a very nice letter."[28]

Fleming again warned that he detected strong undercurrents at work, and that nothing was certain until the job was landed. He ended with some advice.

"One thing is certain if you should get this position you must do us proud. I haven't any misgivings and am certain you can do the work particularly as the position has practically to be made by you."[29]

So wrote Fleming to his protege with just a touch of self-satisfaction.

Now it was Taverner's turn to consider his own situation in the light of recent information, and to show gratitude. This he did in a letter to Fleming in early December.

"I have read over your letter and telegram, Saunders' letters and thought over them both in combination with what Seton said. The first thing that strikes me is that I have a lot of good friends who are working very hard for me. If the position does come my way I hope I will make good though I fear I will have to live to a pretty high standard if all that has been inferred has been said. However I think I can do it though I realize that it will take every effort I am capable of."[30]

One major problem remained. The Civil Service Commission required that positions in the Survey should go only to University men. However, Fleming reported that "Brock makes light of the matter".[31]

During the meeting on 1 December Brock asked Fleming to write a letter to him about Taverner's suitability for the position at the museum. This he did, though not without considerable effort, as he told Taverner.

"On my return from Ottawa I wrote a long letter to Brock, and to show how much I loved you I type-wrote it. It took me a whole day to compose."[32]

Because this letter sums up very well Percy Taverner's interests and skills it is given in full below:

"267 Rusholme Road,
Toronto, Ontario.
December 8th, 1910.

R.W. Brock, Esq.,
Director Geological Survey,
Ottawa.

Dear Sir:

In reference to the conversation I had with you on the 1st about Mr. P. A. Taverner and the curatorship of the new museum, it may be desirable to state my understanding of the requirements, as brought out in our recent interview.

The opening of the new Victoria Memorial Museum will make it possible to give much more room to the exhibition of Canadian Zoology than was the case in the old building, and it will be necessary to make the very best use of the material now available in order that the public galleries may contain an instructive collection that in time will grow to be a representative collection of the natural history of Canada. The curator must have a thorough knowledge of the methods used in preparing groups and specimens, and be able to direct this work, prepare attractive labels and arrange the exhibits to the best advantage. He must understand the requirements of a popular museum, while not overlooking the scientific, and above all must possess enthusiasm for the work.

Mr. Taverner is a Canadian now practising as an architect, a profession that would be of great service in arranging and grouping the exhibits in a museum, he is an ornithologist of high standing, an artist of ability particularly in ornithology, many of his drawings being artistic as well as scientifically accurate, a very rare qualification. He has recently finished the illustrations for Professor Barrows' Birds of Michigan, and has, I believe, begun the drawings for a monograph of the fresh water mollusks for Bryant Walker, the American conchologist; he is an excellent draughtsman and is able to turn his hand to the illustrating of almost any zoological subject. This ability is particularly valuable in preparing exhibition labels and reports. He is a fluent writer, using excellent English and his scientific papers are notable for their clearness. Mr. Taverner has done considerable field work in the region of the Great Lakes, with important results to ornithology. His researches into the fauna of Point Pelee have added several new birds to the Ontario list and extended the range of others, besides adding much to our knowledge of the problem of migration. He spent some years at Ann Arbor where the museum of the university has been a pioneer in the idea of reproducing birds and animals in their surroundings. He there acquired a practical knowledge of taxidermy, later he was with me in Toronto and made many casts of fish and reptiles. I was at that time searching for a cheaper method of reproducing the plants and foliage used in groups such as the British Museum then had on exhibition, and Mr. Taverner was of great assistance in my investigations. As there was no opening for such work in Canada he went to Chicago where he took a course in modelling in one of the Art Schools there, and I have seen several excellent animals he modelled at that time. He also followed closely the work carried on at the Field Columbian Museum and was able to get a good knowledge of the methods which at that time were revolutionary and have since been followed by all the great American museums.

Another qualification Mr. Taverner has is his ability to absorb and carry out the ideas of others. I wrote Mr. Low in 1906 about the new museum as follows, 'the new museum will require someone competent to take the re-arrangement of the collections off the shoulders of the staff, one not necessarily a geologist, but of sufficiently wide intelligence to give effect to the wishes of the different technical branches of the Survey in the rearrangement of the present collections, also someone to take hold of the Zoological part of the museum, in fact, a curator able to make the museum attractive to the public, and yet not lessen its scientific value.'

It is very rarely so many qualifications are present in one man, combined as they are with level headedness, and I feel that with Mr. Taverner as an assistant you can make the museum attractive as well as a national one.

For the last twenty years I have kept in constant touch with the advance in museum methods, and while my time has been necessarily given to the building up of an ornithological collection, I have not lost interest in the subject, and I know that Mr. Taverner has kept informed as I have.

Yours sincerely,
J. H. Fleming"[33]

Shortly after Christmas Taverner received a letter from Brock about the proposed salary if he were

appointed. It was carefully worded so as not to leave Taverner with any cause for complaint.

"I do not think the salary you mention would be too much to pay for the successful and efficient execution of the duties of the position, but I think it might be difficult to make an appointment at that figure. It would be easier to make an appointment at $1600, as this is the initial salary for that Division of the Service, which is the Division in which men are usually appointed for their 'try out'. After a man has proven his ability in this Division, promotion may be made to the Division above, at which the initial salary is $2100, increasing annually $100.00 a year. As you have not had any actual experience in Museum management, I think it would be most satisfactory to follow the course which I have indicated as the usual one."[34]

Fleming also received a letter from Brock about the proposed salary and commented: "It looks like business all right." Always solicitous for Percy's finances he then did some costing based on the figure of $1600 in the first year. He estimated from information given him by acquaintances living in Ottawa that it would cost Percy $12.00 a month for a room in a private house and $20.00 a month for meals at the best apartment house restaurant, so that he could live on about $600.00 a year, but should not count on less. As Taverner was to have an interview with Brock early in January 1911 Fleming invited Percy to stay at his home in Toronto over the New Year holiday. "We may have to give you a cot in the bird room, but if you are welcome to that, I know the birds won't mind." He also made the usual offer to pay his fare from Detroit to Toronto and return.[35]

While in Ottawa Taverner also met Macoun with whom he had been corresponding for the past decade. As a result of the interview he sent Brock an outline of what he thought was wanted for exhibition groups, and a set of his flower pictures to Macoun. After that all he could do was to try to wait patiently.

As a full month from the time of the advertisement in the *Canadian Gazette* on February 18 had to be given for other applicants to reply, the selection of a candidate could not occur before late March. Time dragged on. Eventually a telegram dated Ottawa 22 March arrived at the the Taverners'. This looked like the moment of truth, but when Percy opened it it said:

"Send formal application to Civil Service Commissioners Ottawa for position as Naturalist Preparator and assistant Curator Natural History. R. W. Brock."[36]

Brock followed this with a letter explaining that the previous application from Taverner was not exactly suitable for the position as now advertised. Another disappointment, another letter to be written, another delay. Taverner was getting a foretaste of the workings of the bureaucratic system. However Brock softened the impact, somewhat, at the end of the letter.

"I may say that there is no reasonable doubt of your selection as you have no serious competitors. The Commissioners, however, will defer action until the receipt of the formal application."[37]

At the end of March Taverner was finally informed of the decision. Brock's letter read:

"Dear Mr. Taverner,

It is quite safe for you now to plan to come to Ottawa, as I understand the Civil Service Commission is notifying you that your application has been successful. I am sorry that you should have been kept in suspense for so long.

Yours truly,
R. W. Brock"[38]

At last the suspense was over. Now the challenge of a completely new type of work with new opportunities and new responsibilities would begin. Their home in Detroit with its pleasant garden would have to be sold, and his mother reconciled to moving to a city she did not know. Fleming was quick to write congratulating him and offering good advice.

"I am delighted that the position is at last secure. I have no fear of the result.

It is a great opportunity, the opportunity that comes just once in a life-time ... No doubt you will have all sorts of troubles to contend with but it is for you to decide if you will accomplish anything and I hope at no time will you get discouraged and settle down to the routine of a civil servant which is to draw pay."[39]

There were still a number of points to be settled and at least one more hurdle to be surmounted before the job was assured. The main worry was over the medical examination for entry into the Civil Service. As we know Taverner had a severe illness, typhoid, while a young man in Chicago which caused him to have a slight heart murmur.[40] Naturally he wanted to know how the examination would be carried out. In his reply Brock said that it was usual to obtain a medical certificate from one of the two doctors in Ottawa nominated by the Commission. In reply to Taverner's other queries he wrote:

"We should like to have you in Ottawa as early as possible to discuss matters in connection with the Museum, but I can understand that it is necessary for you to remain in your present position for a short time. I think it is better for you to come to Ottawa before visiting the outside Museums."[41]

For information on the nature of his work, and the extent of ornithological books in the library Taverner wrote to Macoun for guidance. He received a reply from James on behalf of his father. The Museum, he wrote, had a fair library of standard ornithological works including the Awk [*Auk*] and similar periodicals. The nature of his work in the immediate future would be decided in consultation with the Director and Macoun senior. All the natural history material remained untouched after the move from the old building and there were no display cases as yet.

"I need hardly tell you that we are all delighted that you are to join our staff and, like yourself, we anticipate that we shall have a mutually pleasant and profitable time together. Your work, as I understand it, will be practically independent of everything but general instructions."

James mentioned the difficulty of finding somewhere to live in Ottawa as regards rent and locality,

and offered any assistance he might want in finding immediate quarters and information about the different parts of the city. John Macoun, in a handwritten P.S. added:

> "Our specimens are still as they were brought here. The mounted ones were boxed up by Herring. He *must* take all orders from you so commence with that in your mind. Put your own ideas in shape and I will support you; in other words you will have a free hand as far as I am concerned . . . make your own plans and I will help you carry them out."[42]

This friendly note of support from the two men who could help or hinder him most in the first difficult year of his new job must have eased his anxiety somewhat. In fact Taverner might have congratulated himself on coming in on the ground floor when a new museum was being organized, thus realizing his long-cherished dream to work in a museum of natural history and convert his part-time recreation of ornithology into the full time profession of ornithologist. But reading between the lines he might have felt that John and James Macoun were also glad to welcome him at the moment when there was a great deal of tiresome (and dirty) work to be done before the exhibits, for which the Director was vigorously pressing, could be displayed. The problem of the taxidermist, Samuel Herring, was clearly being dumped in the lap of the newest member of the Natural History Division for him to deal with.[43]

It was under these circumstances, and with these hopes and cares, that Taverner made the journey from Detroit to Ottawa where he arrived on the morning of the first of May. It was, perhaps, a symbolic date. Spring had arrived. The tedious years of drafting plans for others, the frustrations of not being free to follow one's own bent and to show one's potentially creative abilities were over; the journeyman draftsman was about to be transformed into a newly fledged member of the species *homo ornithologicus*. But Taverner was a modest man with plenty of common sense and a very practical turn of mind. Even if he had indulged, briefly, in grandiose thoughts or self-congratulations, an incident on the very first day of his new life in Ottawa was enough to bring him down to earth with a jolt; he ran short of money. Fortunately friend Fleming was ready to help. He explained his predicament in a letter of 1 May 1911. He had been hunting for boarding houses all day.

> "However I am a little strained. I found expenses more than I expected and am pretty well on the ragged edge. Salary day is May 15 ... I wonder if you would mind lending me $15.00 until salary comes along. That will fix me nicely. It is rather ignominious to be forced to borrow at the start like this especially when it is my own fault not to have come better provided."[44]

However, this was merely the prelude to more serious problems. By May 10 he had still received no official notification of his appointment so he wrote to the Civil Service Commissioners for a statement of his official standing. He was anxious to get his family to Ottawa as soon as possible but would not do anything until he knew how matters stood. As he told Fleming "... a week and a half of boarding house life is all I want."[45]

Meanwhile, Macoun discovered that the accountant had not received any notification of Taverner's appointment, so he advised Taverner to see the Civil Service Commission about getting his name on the current month's payroll. When he spoke to a member of the Commission he learned that his medical examination was not satisfactory and that the Commissioners were hesitating over his appointment. This was a very disquieting turn of events which Taverner described to Fleming in a long letter written three days later.[46] The reason for the medical examination, Taverner was told, was to guard against appointing anyone who might be liable to frequent attacks of sickness or prevented from working for a long period. To this Taverner replied that he had always understood that if ever his heart defect acted up the result would be sudden; that either he would die of some other cause or "he would drop out suddenly and effectively at once". Since this crisis began on a Saturday morning the Commissioner could do nothing until Monday, nor would Taverner receive any salary until the following month (mid-June). Off went Taverner to Macoun's private house. Macoun was "greatly put out" when he heard the news and advised Taverner to look for Brock "and camp on his trail until I found him". He also volunteered to lend Taverner whatever money he needed to tide him over the month. "I thought that very nice of the old man after so short an acquaintance', Taverner told Fleming.

Luckily he found Brock who had already been informed. Brock explained that the Commission had made a few appointments in recent years which had turned out badly and left them with some invalids on their hands after only a short time.They dreaded the criticism that would follow if they made another such appointment. Brock said frankly that "if there was anyone else visible [and] competent to fill the position they would have turned me down immediately". This was not very flattering to Taverner but he did not complain. Instead he commented realistically "but there isn't and it is either me or no one." Brock then explained the alternatives if the second physician also gave him an adverse medical report. Either Taverner could sign a clause to the effect that he would resign in case of serious disability, or he could have a contract with the Commission to carry out specific work only.

Still in the same letter to Fleming Taverner said that he had already prepared a draft report on the state of the existing zoological specimens, and a plan for their public exhibition. He had shown this to Macoun who seemed quite impressed. Taverner remarked candidly:

"He is a great field man but very little use as a museum head and I think he realizes it and wants someone who is perhaps to cover up this weakness in him and perhaps in Jim who is scheduled to take his place."

Taverner believed that if his report had a similar effect on Brock this would be important because Brock had enough power "to force me through if he can get me no other way".

Taverner was undergoing a hard introduction to the world of the Civil Service and its workings. It is hardly surprising that a few days later, in a letter replying to one from Fleming advising him not to remove original labels from any of the skins, he reported on his health.

"My stomach seems all out of condition and the last two days I have been wretched. I have obtained medical advice and hope that in a few days I will get set up again. I rather imagine that the change in water is likely largely responsible."

Perhaps that is true.[47] But equally it could have been the result of a fortnight of anxiety during which his desire to get on with his challenging job was being frustrated. This, alone, was enough to give Percy an acid stomach. Yet he kept on working as best he could, unsalaried and in a state of acute uncertainty. Such a situation would have been upsetting enough for anyone who was able to express himself orally with ease. But for Taverner, with his recurrent stammer, especially when he was in a state of anxiety, it was ten times worse. That he kept a cool head and survived is a tribute to his stamina. Certainly he was helped by Fleming's knowledge of the bureaucratic system, and by his steadfast friendship. Fleming's forthcoming visit to Ottawa was reassuring. But the only assurance that could settle Percy's peace of mind came at the beginning of June when he was informed that he should present himself before the Clerk of the Privy Council to take "the oath of allegiance". As he told Fleming, "Now if I can only get on the next salary list without having to wait for the meeting of Parliament again all will be lovely."[48] On June 5 he sent Fleming a postcard showing the main entrance of the Museum with the words "Appointment all fixed".

At long last, as though by metamorphosis, Taverner the draftsman emerged as Taverner the ornithologist.

# Part III - Challenge of the National Museum 1911-1919

## CHAPTER 6. Museum Development (1911-1914)

When Percy Taverner began his new career in 1911 at the Victoria Memorial Museum in Ottawa (hereafter referred to for convenience as the National Museum of Canada)[1] he was involved in something that a museum staff does not normally experience. He was taking part in the development of a major museum almost from the beginning in a newly completed building, with very limited staff and almost no equipment. It is true that a small museum containing several random collections already existed, but the sudden transition from that situation to the founding of what was to become a large modern museum was an exciting challenge to all those involved. How Taverner reacted to this situation and what he achieved during the following nine years is the subject of the next four chapters.

However, before going into details of the problems Taverner faced and how he coped with them, it may be worth looking at the attitude in North America towards museums by 1910 and, at the same time, to relate this to the state of ornithological studies. In Canada at this time there were only a few museums and even fewer with natural history collections of any significance. Museums need wealthy donors or foresighted city fathers to found them as well as grants and donations to maintain them. Canada, in the nineteenth century, with its small population and struggling economy was not in a position to enjoy well established museums.[2] However, by the first decade of the twentieth century, with an improvement in the economy, the founding of the National Museum in Ottawa and the Royal Ontario Museum in Toronto was possible. The building of these two museums acted as examples that stimulated the development of other museums in Canada during the twentieth century.

Luckily for Taverner, he had been in touch with developments taking place in some of the major museums in the United States in the period 1890-1910. He also had a fair idea of the state of ornithological studies in the United States in this period and the way in which these studies were being carried out in some major museums there. For instance he was well aware of the emphasis put on the economic importance of bird studies in relation to agriculture ("the pest or friend" simplification). Also he was informed about migration studies that were then attracting the attention of many ornithologists, professional and amateur. Moreover, the collection of data on bird migration was given impetus at this time by the first steps in North America to develop a technique of bird "tagging" (banding) in which Taverner himself played a part at the very outset.[3] Also related to the problem of migration was the study of bird distribution and the analysis of the data being collected in local bird lists. In the first decade of the twentieth century *The Auk* and *The Wilson Bulletin* regularly published faunal lists to which serious

Canadian amateurs such as Taverner, Fleming and Saunders contributed. Other topics covered in *The Auk* were studies of the breeding of various species, and studies of the taxonomy of certain genera, a subject in which Taverner played a minor part.[4] Another subject that attracted many ornithologists was bird behaviour which came to play a popular role through the growing number of "life history studies" in the 1920s onwards. One of the attractions of this form of study was that the observer could concentrate on a bird's habits entirely apart from taxonomy. It was Charles Bendire's *Life Histories of North American Birds* that led the way in studies by other amateur ornithologists which subsequently became popular.[5] Another subject with which Taverner was familiar through practical experience was bird photography. He was alert to the value of photographs in books by ornithologists who were also pioneer bird photographers such as Frank Chapman. His close-up photography of a Common Snipe and a Northern Saw-whet Owl showed his own ability with a camera.[6]

By contrast, studies in ornithology in Canada by the year 1910 were much less advanced. The era of exploration of the Dominion's avifauna had barely begun. Canadian ornithology was still at the early stages of surveying its bird fauna, and much useful work could be carried out through local annotated lists. This was something that Taverner encouraged from the first years at the National Museum because he quickly discovered how much work needed doing on geographic distribution, especially in certain regions of the country.[7] Migration was a subject that few ornithologists and natural history clubs in Canada had seriously begun to tackle. If keen and knowledgeable ornithologists such as Fleming, Saunders, Taverner and Swales working co-operatively over a period of six years in such a favoured place as Point Pelee could discover only limited information about migration there, what could isolated observers elsewhere in Canada be expected to achieve? Some progress had been made in the study of nesting behaviour, and a number of large egg collections had been built up. A few people were in process of studying various aspects of the life history of birds, though not very systematically. No one in Canada at this time appears to have been making studies of one particular species. It would be another forty or fifty years before studies of this type became established. The first step forward in this field began when those who were knowledgeable about certain aspects of the life history of a particular bird contributed their knowledge to Bent's series of *Life Histories of North American Birds* which began publication in 1919 as Bulletins of the U.S. National Museum. However, many Canadian naturalists in the decade before 1910 kept a regular journal, or other extended record of field observations. From these records some wrote papers or notes on their observations which were published in the ornithological or natural history journals of that time; in *The Auk, The Wilson Bulletin, The Condor, The Ottawa Naturalist,* and *Le Naturaliste canadien*; as well as in publications by learned societies and by government.

Another aspect of ornithology in the early years of the twentieth century was connected with conservation issues. In the United States the movement for the conservation of wildlife through preserving wildlife habitat reached prominence in the 1890s with the campaign of John Muir and others to arouse public feeling. This was the decade in which Yosemite National Park near San Francisco was established and the Sierra Club was founded. A few years later the Audubon Society, devoted to the conservation of wildlife and the natural environment, was established, and soon became influential through its local clubs and its official magazine *Audubon*. In addition to Muir, another man important in rousing participation in this growing movement was William Hornaday, director of the New York Zoological Park from 1896 until 1926.[8] As a zoologist Hornaday became well known for his warnings that the sheer numbers of a species could not guarantee its survival in the face of human killing as the dramatic decline of Bison in North America showed.[9] For Taverner, living in the United States at this period and reading accounts of these issues, the conservation movement impressed on him the urgent need for action to preserve wildlife habitat. The remark he made in 1907 that he wished he could speak persuasively because then he would seek public support for the preservation of Point Pelee is evidence of this. In 1907 he already had the vision to realize the need to make Point Pelee into a nature sanctuary although he lacked the means to carry it out.[10] In Canada at that time, wildlife issues were only just being identified. When Taverner joined the National Museum there was only one officially recognized bird sanctuary in Canada and a national movement to protect migratory birds did not exist.[11] However, the establishment of a Federal Commission of Conservation in 1909 showed that the problem had been officially recognized. For many years subsequently, Taverner was himself officially involved in the protection of birds and their habitat through his position as ornithologist at the National Museum.

When Taverner settled into the National Museum in May 1911 he had time to reflect on his change of occupation and place of work. From his sparsely furnished office on the third floor he looked out over the roofs of Ottawa rather than the streets of midtown Detroit. The work that faced him was not something handed to him by an employer week by week; he now set his own tasks and priorities. On 10 June he entered his thirty-sixth year. For the first time in his life he was responsible for planning the

scope and organization of his own work, and the work of one man under his orders. Fleming's recent warning that Seton, Saunders and Fleming would expect great things from him ("you must do us proud") was sharply in his mind. At last Percy had been given the chance that he had wanted for so long, the chance to work professionally in ornithology and to do something that he considered worthwhile with his life. The responsibility was considerable — almost daunting, because the future development of ornithology, not only at the museum but also throughout Canada, depended to a large extent on how he tackled the tasks before him during the next decade. Taverner was the first professional ornithologist to be employed in Canada. It was up to him to set the right course and to generate widespread appreciation of the study of birds.

Before becoming immersed in the mass of detail that would continually need his attention it was important that he should have a clear idea of what a museum was about; what the objectives and priorities of sound museum management should be. The basic principles were not greatly different eighty or more years ago than they are today, though the techniques have changed considerably. A museum is based on collections of things. For Taverner the raison d'être of his work was to build up an ever expanding collection of bird specimens; birds mounted for display, and skins arranged in drawers for research. But bird specimens are fragile and very susceptible to damage. Therefore they need continual care to preserve them from deterioration. Yet representative and well preserved collections of artifacts or natural objects are not much use if they are seen only by their curators. The main object of any museum collection is that a part of it should regularly be on view to the public. But as it is only possible to display a fraction of any collection at one time the major part is preserved in workrooms and laboratories where it can be used for research by scholars. The problems and frustrations that Taverner faced during his first decade at the museum can be better understood by reference to three main categories — exhibition, preservation and study — which constitute museum collections and need continual effort and financial support. Taverner's dilemma resulted from having to decide exactly what priorities to allot when there was insufficient staff and money to do a satisfactory job in each of the three categories simultaneously.

His first impresssion of work at the Museum was one of limited chaos, and he fired off a stream of letters to Fleming describing the position.

"As to the museum here. Well I can not tell you very much about it yet. Every one seems to be hustling about very busily but as far as I can see no one accomplishes anything. Indeed no one knows what space they are going to have or what they are going to do. There seems to be a spirit of expectant waiting for something."[12]

Taverner had his hands full taking a preliminary look at the zoological collection, both of birds and mammals, and deciding on the general layout of the exhibits based on them. As he told Fleming, there were two large halls in the building allotted for zoological exhibits each lighted from the sides and lined with radiators in such a way as to leave no lower wall space available. The halls were separated by a square rotunda with a gallery all round.

"My present idea is to give one of these wings up to a general survey of Canadian zoology showing groups illustrating the typical forms of life in each faunal group. For instance on the south side of the room having three main groups illustrating the southern fauna of the Dominion, namely Eastern Woodland, Prairie and Mountain. Across the room have a series showing the same for the Hudson Bay, Mackenzie and the Yukon and Arctic forms."[13]

He proposed to devote the other wing to "special-problem subjects" to illustrate things such as geographical distribution, seasonal changes, and protective coloration. An immediate problem was the large size of some of the mammal groups. One was a group of musk oxen in the snow mounted by the firm of Ward's Natural History Establishment in Rochester, fourteen feet square. Other animals for mounting at Ward's included Mountain Goats, Caribou, Dall's Sheep and Moose. He proposed to display only a *small* exibition in the fall because he realized how important it was to begin in the right way with a properly tested plan and not to have a lot of cases made up quickly which would have to be discarded later. His immediate problem was to design display cases of various sizes and shapes to fit the idiosyncrasies of the museum's halls. Temporarily, at least, the need to mount a display for the public had priority.

After Taverner had examined the bulk of the bird specimens he was anxious to start on them immediately. He told Fleming that he wanted to re-label and catalogue the whole lot and to clean and shape all the duck skins that needed it. This, he said, would be useful work to give Herring if only he would do it.[14] But Herring was getting old, had little respect for Taverner, and no wish to work on a pile of greasy ducks. He refused to take the first order Taverner gave him, and Brock had to intervene. When Herring eventually responded he did the job in such a way that Taverner told Brock that he was incompetent, and his employment was terminated.

At this point Taverner summarized the problems facing him in a preliminary report to Brock on the vertebrate collections dated 12 May 1911. He found that the mounted material was not up to the standard of modern taxidermy work and suggested it should gradually be weeded out. The study specimens needed immediate attention. Many carried field labels, hurriedly made on scraps of paper, while the localities in which they were collected were marked only

vaguely. Some labels were almost indecipherable. He advocated that a new system of labeling and cataloguing should be used, and explained what he had in mind.[15] He also emphasized the need for proper storage cases for the study collections to make them safe from pests. Since the vertebrate collections needed thoroughly overhauling a properly trained and up-to-date preparator was urgently needed. In his report to Brock he was not too hard on Herring when he wrote:

"The least said about our present taxidermist the better, as it is to be remembered that he is an old man versed in the ways of fifty years ago. . ."[16]

All these were very practical matters; but in addition Taverner needed to set down his thoughts about the future scope of the collections. What, for instance, should be museum policy on the limits of the geographical area from which birds and mammals should be collected? Taverner's suggestions did not originate with himself since the matter had to some extent already been decided before he joined the museum. The Geological Survey of Canada, under which the museum functioned, was concerned with the discovering, surveying and mining of minerals only within Canada. Therefore, objects already collected by members of its field parties for preserving in its museum had come from within Canada. Brock, in the Summary Report for the museum for the year 1910 devoted one paragraph to the policy and objectives of the museum just then being organized. This set out an interim policy.

"The Victoria Memorial Museum is a Natural History Museum including biology, geology, and mineralogy, ethnology and archaeology. As the National Museum of Canada it is hoped that it will become the repository of all objects of scientific value found within the Dominion. To fulfil its mission, it is necessary to secure the interest and co-operation of the Canadian scientists and of the public generally… For the present, at least, the Museum is confined to Canadian material, the object being to specialize in this until it becomes in all branches thoroughly representative of the whole Dominion, a place where the entire natural history of Canada may be studied."[17]

In his report of 12 May Taverner followed Brock's lead but left the door open for collecting from a far wider perspective, when he wrote:

"The Museum being under the Geological Survey of Canada gives it a National character at once, nor do I think it advisable to make any great effort to extend it beyond this limit, at least for the present. The time will certainly come when it will be necessary to broaden out and give its collection a world wide character both for the education of people in general and for the benefit of future Canadian zoologists for *it is evident that life is so complex in its distribution that knowledge of Canadian conditions cannot be accurately arrived at without taking into consideration extralimital examples and experience.* [emphasis added]"[18]

Taverner assumed that when the right time came government would authorize the collection of material from beyond the limits ("extralimital") agreed to in the early years of the museum. But a precedent had been set from the beginning and it became "cast iron". In subsequent years, whenever Taverner recommended that specimens from the whole of the North American continent should be collected his advice was disregarded.

Taverner then devoted several pages in his report to the problem of how best to organize and present zoological exhibitions. He recommended the grouping of material so as to present the chief characteristics of various areas of Canada illustrated by the use of "typical animals and natural accessories carried out botanically, entomologically and in every other way to the last decimal point of zoological accuracy…"[19] He said that he had read all the reports he could find on the current arrangements in some of the major North American museums as well as the British Museum, but before adopting a final policy it would be necessary to visit some of the main museums in the eastern United States. In the last paragraph of his report he asked Brock to consider carefully the various points he had raised.

"I am interested in making this institution take its place among the great institutions of the world. My scientific future is wrapped up in it and if I make a name for myself it will be through it. Maybe all the points discussed cannot be carried into effect at once but they form a mark to aim at and will, I think, eventually greatly assist in the reputation and the prestige of the museum and incidentally of all who have any connection with it."[20]

Taverner was still waiting to take the oath of allegiance on becoming a member of the Canadian Civil Service. Fleming, with his impish sense of humour, teased him by writing

"… let me know when you have been iniciated [initiated] someday you will rise to be a deputy minister and attend levees in Windsor uniform with a sword between your legs great are the possibilities."[21]

No chance of Percy becoming pompous with such a friend — he might trip over his sword. Finally he was able to tell Fleming the news.

"I took the oath of allegiance the other day so now I am a Canadian citizen again I suppose. Guess things are all right now."

Under his signature he typed "Assistant Curator" and under that he wrote "Ha! Ha!"[22] In the same letter he described to Fleming how Prof. Macoun, Charles Young and himself had recently gone on a day's collecting trip to Mer Bleue on the east side of Ottawa.

"It is a great sphagnum bog covered with *Kalmia* and pitcher plants and straggling patches of tamarac and some conifer. . . The Palm Warblers were breeding there rather commonly but all found had young. It is most astonishing to see Prof. Macoun in the field. Works through swamp, thicket and meadow with all the energy of a young man. He is a wonder."[23]

One evening he called on a prominent Ottawa naturalist, George R. White, who lived beside the

Rideau River.[24] This was the first link in what became a large network of naturalists across Canada who would collect birds for the museum and keep Taverner posted with valuable bird information.

By now Taverner realized that when he came to "figuring out detail" how much he needed to make a tour of some of the museums in the USA. He also realized the magnitude of his task at the museum.

"It is really a full sized job I have tackled and at every turn I wish I were better equipped for it."[25]

Nevertheless, his first report shows that he had a fair grasp of museum work and management. He had the draftsman's eye for visualizing arrangements of furniture and the items to be exhibited, as well as the skill of hand to produce plans and to work with wood. When it came to mounting the exhibits he showed all-round ability and considerable resourcefulness. Early in June his visit to the States was approved by Brock and he wrote to Fleming for advice — what museums did he advise him to see, who was the man at Washington from whom he could get the most useful information and other questions.[26]

Soon he was in Boston taking notes, measurements and observing everything. From now until the end of the month he wrote several detailed accounts to Fleming as from one museum man to another. At Harvard, he was critical of a few particulars. For instance the museum tried to combine a scientific and a popular exhibition which, he felt, did not succeed, partly because the labels were not well designed. Some of the mounting and background painting, however, was excellent. He also learned some useful things about chemical formulae. One disappointment: he could not talk with the taxidermists.

"Was told that the taxidermists were close mouthed and would not tell anything. I think, however, I see how much of it is done. Did not meet them."[27]

Since Taverner was looking for a taxidermist whom he could lure to Ottawa the people at the Harvard Museum were being cautious with good reason.

At the American Museum of Natural History in New York he was able to look over the Preparatory Department and to meet all its staff. As though to make up for the years when Fleming went to all the AOU meetings but Taverner was unable to afford the expense or the time away from his job, he now met some of the outstanding American ornithologists of that time including Frank Chapman and Louis Agassiz Fuertes, the bird artist. He also met William Hornaday, Director of the New York Zoological Park, who gave him permission to take photographs in the grounds of the Zoo.[28] However, Taverner kept his critical faculties in face of the excellence and size of the American Museum. He reported what he had seen but that he found the museum at Brooklyn almost ideal.

"It is not as elaborate of course as the American but personally I think it is in better taste and just what I should like to make ours. The exhibits are arranged in an order that he who runs may read — everything shows something and when the point is shown plainly and clearly it stops without confusing the beholder with a great multiplicity and reiteration."[29]

While at the Smithsonian Institution in Washington he spent a whole morning with Charles Richmond who showed him, among other things, the system of book keeping and specimen-preserving in his department.[30] Taverner also spent time with Wells Cooke, the authority on bird migration, who explained his card systems at length. Taverner commented perceptively about Cooke in his report to Fleming.

"I think his greatest delight is in making out cards — one card to a note. His system is perfect but when one has made it all out I do not see when he can get time to do anything else. I understand why he is so inaccurate."[31]

From Washington he went to visit Ward's Natural History Establishment at Rochester to examine their stock and see their methods of mounting mammals. This firm was working, under contract to the National Museum in Ottawa, on a group of Dall's mountain sheep. Next he went to the museum of the University of Michigan at Ann Arbor. Here Norman Wood and other friends from his Detroit years may have greeted him; the same "lovable" Percy with a warm sense of humour but now a professional with the cares, and satisfactions, of a museum department of his own under his guidance.

From Ann Arbor he went to Chicago, to the Field Museum where he used to spend much of his spare time while living there in the years 1902-1904. Here he was well received by the curator of mammalogy and ornithology, W. H. Osgood, and made a careful study of their exhibits.[32] On the way back from Chicago he managed to stop at Detroit, sell his house, and bring his mother and sister back to Ottawa with him in mid-July.

His next task was to write a report on his trip to American Museums. After outlining the same itinerary that he described in his letters to Fleming he said how much time the curators spent showing him round and explaining plans, methods, and in giving advice. As a result of this visit he felt that the general scheme of exhibitions he had previously outlined need not be altered. The trip had served to crystallize his thoughts and had brought his methods into sharper outline. His most important recommendation was for a staff of museum heads to work under the curator in charge of natural history. Also a good mammalogist was very necessary as well as a herpetologist "if we are to do work that will measure up to the standard set by the serious museums on the other side [of the border]."[33] Now that he had visited some outstanding American museums Taverner was consciously measuring the future development of his

own museum by their standards. A preparatory department was also needed with a good taxidermist and an assistant. He pointed out that the system of sending taxidermy work out to commercial firms did nothing to develop skilled craftsmen along scientific lines. No one could realize the great steps that had been taken in museum methods and techniques until they had seen the work being done at the most advanced museums in the U.S. But, Taverner warned, good taxidermists were scarce and hard to "draw away" from their present employment.

Other problems of less magnitude, but none the less troublesome, faced Taverner in his task of organizing the collections of mammals and birds in the new museum. There were only two workrooms in the basement which were quite insufficient for the preparatory work. At that time there was no heating in the basement, though it was proposed to install electric heaters, but Taverner doubted that they could supply the necessary heat.

> "I do not see how the work can proceed without gas. This is the only museum in the country and perhaps in the world that is not supplied with gas for the necessary heating process."

He advised that the study skins should be on the top floor away from basement dampness and near to the offices. For cabinets he recommended the new design recently developed at the American Museum which had sliding doors that "are dust, insect and fire proof". As regards the catalogue system for vertebrates he proposed four distinct catalogues, one each for birds, mammals, reptiles and fish. Then, as special curators were appointed, the records of each department could be turned over to the proper officers, while Taverner kept the bird records. Registers and index cabinets were needed to begin the record keeping. Exhibition cases should be ordered and a typewriter acquired.

> "The present one is my own property and badly worn and besides cannot be used for writing index cards"

which, he explained, was a prime need in his department. He would shortly submit plans for dividing the upper floor into offices and specimen rooms. Finally, so that there should be no misunderstanding, he made a resumé of the points which required immediate action. He signed himself "Assistant Curator".[34]

Work now began on the arranging of the bird specimens by years according to the dates of arrival at the museum. As he explained to Fleming the condition of the labels was very bad. Luckily he was able to make the temporary appointment of a young man by the name of Hennessey to help him with this work "until college opens".[35] The re-labelling was tedious work which involved tracing the history of the accessions already belonging to the bird collection by carefully deciphering obliterated labels, searching maps for little-known localities, and research among various reports and old records preserved in old registers and manuscript lists.[36]

Taverner's other main preoccupation was with his catalogue system. He abandoned the idea of a card to a species in favour of a card to a specimen because it seemed a better way of keeping track of loans, and for cataloguing distributional studies. Tired of waiting to have the printing he needed done by Government he found a small printing press in the building. With this he made enough cards to try out his method, sending some to Fleming for his comments. The name of the province was printed in the corner of the species cards.

> "I am getting a large Dominion map to lay out on my work table with glass over it. I intend to mark on it all the localities represented in the collections and the routes of various expeditions. I think it will be very handy for I can then lay my species cards out on it according to their locality and thus get the distributions at a glance."[37]

This is an interesting statement because it pinpoints the origin of one of Taverner's major contributions to Canadian ornithology, namely the system which he devised in 1911 and maintained until his retirement in 1942 for keeping track of the distribution of Canadian birds. When the system was finalized it consisted of a series of large-scale maps in a binder on a large table on which bona fide records of birds were plotted, and the information for each record was noted on cards arranged by species and filed in adjacent cabinets. There were two sets of cards: one dealing with published literature, the other set with unpublished information derived from correspondence and field notes. Fleming replied to this letter with good advice on cataloguing skins and the value of a printing press because one can print the locality where a bird was collected and the name of the collector. Moreover, unlike any other ink, printer's ink is permanent. Using a card to a species it ought not to be necessary to give the scientific or common name, the AOU number on the cards should be sufficient. But Fleming had forgotten that the AOU numbers might be changed from time to time, causing trouble to the user of this method.[38]

In answer to Taverner's news that at long last his appointment was formally acknowledged and that he had received his first regular salary Fleming moralized "beyond keeping out of debt and enough ahead for sickness you can live comfortably and go on with your work."[39] It seems that Percy was still Fleming's protegé.

Meanwhile Fleming was always ready to put Percy in touch with people who might help him in building up the museum collections. Late in 1911 he wrote that he was in touch with a man named Munro in British Columbia about the possibility of getting Trumpeter Swans.

> "If you want anything collected at Okanagan Landing J. A. Munro will be glad to get you skins, if you want anything for groups he is open to engagements and would be intelligent as well as reliable."[40]

As a result James Munro became a collector for the Museum and a lifelong friend of Taverner. This raised the subject of what was a fair price to pay for birds bought by the Museum. Percy had recently written to Fleming about the possibility of selling his own collection to the National Museum, and asked him to suggest a price. Fleming replied that fifty cents per bird was well within the range, that collecting birds in the field averaged $1.00 per bird.[41] Eventually Taverner's own collection of over 1000 skins was acquired by the Museum at 50¢ each. By the end of the year he notified Fleming that the registers had arrived, and that he had sorted the mounted birds and the study skins into accession dates ready for cataloguing.

In 1912 Taverner's horizons expanded with the prospect of acquiring more bird specimens. By now 3900 specimens had been catalogued but more remained to be entered. The Museum still wanted almost everything. Only southern British Columbia and the international boundary to Manitoba were well represented but most of the far northern material collected earlier by G. M. Dawson, R. Bell, and others had disappeared. Taverner knew that to build up the collection of specimens it would be best to start collecting systematically each summer with a zoology team organized by the Museum. One project he had in mind was to work the islands at the mouth of Georgian Bay and then across north of Lake Superior to the Manitoba line. "All this is *terra incognita* to us."[42] Meanwhile things were going forward very slowly at the Museum as though something was wrong. In March 1912 Taverner informed Fleming that he had had a long "conference" with Brock. Brock seemed to be afraid to talk "right out", and although he had good ideas he did not seem to be putting any of them into practice. Taverner suspected that Brock was hampered by the old staff at the Geological Survey; that he doubted their capabilities but hesitated to promote new people over them. Things at the museum seemed to be at a standstill, and the only thing that seemed to be developing was the crack in the tower. Taverner commented:

> "The crack is doing itself proud, growing and flourishing like the proverbial green bay tree. Guess as soon as spring weather comes we will lose our tower."[43]

To this Fleming replied:

> "I hope you have taken out that accident insurance I told you to, it will be a tower of strength to you if that crack widens."

In the same letter Fleming gave Taverner some news of the Royal Ontario Museum which was now in the planning stage.[44]

From 1912 until the end of his career in the National Museum thirty years later Taverner kept up an astonishingly large correspondence with other ornithologists, both professional and advanced amateurs in Canada and the United States, much of which was about technical matters. There was plenty of challenging work to be done and Taverner soon took up the challenge. Writing to Fleming early in 1912 he mentioned that so far he had been concerned with getting each bird properly labelled, numbered and entered and had therefore paid very little attention to "determinations".[45] This is a term in taxonomy that is applied to the process of determining to what species, or subspecies, a particular specimen belongs. In order to make an accurate determination a taxonomist may have to compare a specimen with many others in other collections.

Determining the correct identification of specimens is one very important aspect of the work of a curator in ornithology and is a continuous process. As an example, the museum had three skins of sandpiper which Taverner considered to be the Aleutian Sandpiper, a subspecies of the Purple Sandpiper. These were in "intermediate" plumage. He explained in a letter to Fleming that the museum had some mounted Aleutian Sandpipers which would have been useful for comparison but these were in full plumage and so could not be used. He sent Fleming two skins to examine. Also in this exchange of letters Taverner mentioned that he had a breeding record of a Great Gray Owl from Nippissing District, Ontario, a bird which was in downy plumage. Fleming asked for more information explaining, "We don't know what the first plumage of the Great Gray Owl is, so if you have found it you are in luck … how many and what feathers did you get?"[46] Taverner had received feathers from the wing and tail which identified it, and his informant said the bird was still largely in down. Taverner arranged to buy it for the museum for $5.00.

When Taverner moved to Ottawa he left behind the birds and migration of the Great Lakes Region, with which he had begun to be familiar, and suddenly had to face the bird life of the whole of Canada including the Pacific and Atlantic seaboards and islands, the Canadian arctic, and the migration patterns between the whole of Canada and the United States. He started from very limited knowledge and needed as much help as he could get from experts. Fleming was valuable for eastern birds but less so when the intricacies of western birds were involved. What Taverner needed was an experienced ornithologist living in British Columbia with whom he could correspond regularly. Meanwhile he did not let matters rest for long. In a letter to Brock he set out the immediate needs of the museum such as the problem of pests eating the specimens. He hoped that the points he had explained would show Brock the need to consult with those who were best qualified as judges of their own special requirements. The museum building was very poorly planned because it failed to embody practical museum ideas. Such mistakes could only be avoided in future by consulting those who used the building. He asked that an oppor-

tunity could be given members of the staff to present their views and requirements before important matters were decided. The letter contained a note by Macoun typed below Taverner's signature endorsing Taverner's letter.[47] A few days later Taverner had to write to Brock again, this time to put on record that his typewriter (his personal property) had broken down and was too old to be worth repairing. He asked for a new one, and in the same letter pointed out that it seemed poor policy for him to spend his time typing when a stenographer could do it more quickly and better than he could and at less expense to the museum.[48]

In May 1912 Brock worked out a plan of organization for the museum and set up a committee of all Geological Survey officers interested in the museum. The executive committee consisted of H. I. Smith, archaeologist, L. M. Lambe, paleontologist, R. A. Johnston, mineralogist and Taverner representing the biological division.[49] This gave him leverage to push for hiring additional staff and in July a proposed list of specialists for the biological division, including a taxidermist, was adopted.[50]

At the end of April Macoun, now in his eighty-first year, left Ottawa accompanied by his son Jim for Vancouver to spend the rest of his life in Vancouver Island happily collecting specimens of the flora. Macoun and Taverner said goodbye, and although they never met again they kept in touch with each other by correspondence. Taverner had come to like John Macoun as he made clear in a letter to Allan Brooks.

> "Prof. Macoun though he admits knowing little of birds is a wonderful old gentleman in many ways and since I have come to know him have had a great admiration for him."[51]

In 1908 a separate topographical division of the Geological Survey had been set up to meet the need for making accurate topographical maps. Taverner discovered that members of the staff were interested in the work of the zoology department and would gladly bring back material from field expeditions if they had a little instruction in its preparation.[52] To supply this need Taverner began preparing a set of instructions for the collection of zoological specimens as well as a method of note-taking based on the monthly notebook he had devised for himself in 1905. A few months later these instructions were produced in booklet form by the Government Printing Bureau.[53] In the introduction Taverner pointed out that visitors to Canada on hunting or scientific expeditions usually deposited the results of their excursions with their national repositories such as the Smithsonian Institution and the British Museum. He appealed to Canadians whose work or sport took them to out of the way places in the Dominion to remember the Victoria Memorial Museum as a legitimate recipient for any zoological specimens they collected but did not wish to keep as personal trophies. Specimens acquired by the museum would be kept safely and put to the best scientific and educational use. They could also help by making notes and gathering information on the distribution and habits of Canadian wildlife, because records from localities little studied were invaluable in estimating the zoological resources of the country. The instructions covered birds, mammals, reptiles, amphibians and fish, insects as well as land and fresh water shells.

In a general section on zoological collecting Taverner set out principles for what to collect and how to collect it, and incidentally gave the reader a useful summary of the outlook of an ornithologist and mammalogist working in a museum. For instance a good rule when collecting in localities about which little is known is take what seems most characteristic of the place, because what is recognized as common in many places may well be rare in a little worked locality. Certainly collect species that are known to be rare but also collect common species to give an idea of local conditions. As regards birds the most characteristic forms of any locality are the summer residents; specimens of breeding birds are essential as they give an idea of local ecological conditions better than do migrants passing through. Many species vary geographically. Thus a species found in eastern Canada may differ noticeably in coloration or size from the same species in western Canada. On the other hand the forms of a species or family which are found in a little studied locality, may be identical with those from a well studied locality, but are nevertheless valuable as showing a lack of variation in that locality. But specimens are needed as proof. To drive home his point Taverner coined an aphorism. "Never neglect the inconspicuous; striking beauty or unusual form are no criteria of scientific value." For study collections specimens were required of each species in every possible natural condition, in every plumage or pelage, worn or moulting as well as full breeding plumage or thick winter coat. Specimens of young, of moulting or changing plumages or birds, or summer coated animals difficult to find, were especially wanted as the museum was weakest in this line.

After stating the principles of collecting Taverner set out the principles of preparing specimens in the field and the care of skins. Again he highlighted certain basic rules. For instance that no matter how rare or valuable a specimen may be, unless full data on it are attached it is practically worthless. A good label without a specimen has a certain value but a specimen without a label is valueless. He stated exactly what information each label should contain, such as the altitude at which a bird or mammal was collected because, he explained, altitude has a lot to do with distribution. The sex of the specimen should always be stated. One must determine this by dis-

section. Do not put your own inferences or conclusions on labels, only the ascertained facts; all other material should be recorded in your field notebook. Next, Taverner went into considerable detail drawn from his own experience on the best equipment to use. "A pair of field glasses is nowadays almost indispensible to an ornithological field worker." Modern prismatic binoculars, he said, were best for the job. Then followed a very detailed description of how to skin and "make up" a specimen down to the formula for making arsenical soap. All the information and expertise in this section was based on the first hand training he got from A. B. Covert at the University of Michigan Museum, in his many discussions with Fleming, from taxidermists such as Oliver Spanner and from work in the field with Saunders at Pelee. He also learned much about basics by continual reading of Coues' *Key to North American Birds*.

When writing the section of the booklet dealing with mammals he had to rely on information in books, and from the advice of taxidermists who were expert in making up mammals of all sizes. The "sport" of hunting animals and having them made into trophies was widespread and Taverner himself had seen many such trophies being mounted in taxidermy shops in the past. For the section on insects he could use the expertise of "Bugs" Young at the Museum, while A. G. Ruthven of the Museum of the University of Michigan supplied advice on collecting reptiles, and Bryant Walker, a friend from his Detroit days, allowed him to use his pamphlet on the collection of land and fresh-water shells. The writing of a booklet of this scope showed something of Taverner's flexibility and experience, and the value of his network of friends and acquaintances. In the same period he prepared a field note-book for recording daily observations on flora and fauna. He expected that this would be of considerable use because it could be kept by members of the various staffs of the Geological Survey without interrupting their field work. In his report for the year 1912 he explained that "by their use we expect to obtain exact data on comparative abundance and distribution of many species in many out of the way localities."[54]

But no plans to enlarge the collections significantly could succeed without a competent taxidermist. As a result of his visit to museums in the States in 1911 Taverner had heard of a taxidermist by the name of Clyde Patch who might be willing to come to Ottawa in the future, but nothing further could be done until a post existed for one. This happened in July 1912 when the Museum committee agreed that such a position should be requested. After Taverner had attended the AOU meeting at Cambridge, Massachusetts, in November 1912 he took the opportunity of going to New York, in the company of C. H. Young, and spent a week in the American Museum of Natural History and the Brooklyn Museum. While there he was able to meet Clyde Patch and discuss details with him. The prospects seemed promising. Writing to Swales he explained: "In New York I think I found a jewel of a taxidermist and expect to get him here later on in the winter. I need him badly. I am planning on taking him to Point Pelee next spring to make a collection for a Canadian Carolinian group, as the first of a series of geographical distribution exhibits."[55] Clyde Patch was appointed chief taxidermist to the National Museum from 1 May 1913.[56]

In a letter to Fleming in December 1912 Taverner looked back on the slow progress he appeared to have made in organizing the zoological department since his appointment. He realized that the work of cataloguing and organizing, while extremely important, made no show at all and was appreciated by hardly anyone at the museum. However, he felt that he had made pretty good order out of chaos. "You can hardly imagine what a disgraceful order or lack of order things were when I came here." In the same letter he mentioned another matter which was that until Clyde Patch was secured he would be unable to mount any exhibitions. He was very anxious to make a showing because he could hardly expect a raise in salary until he had shown what he could do. In the zoology section of the annual report for the year 1912 he sounded a note of urgency about the need to collect specimens before it was too late. He suggested that in addition to the Geological Survey other survey and exploration parties were sent into the field, and if a naturalist could be attached to them specimens could be collected inexpensively. Taverner showed foresight when he wrote:

> "The Canadian country is changing rapidly from an unsettled state to that of civilization and cultivation. This is having a most profound effect upon our flora and faunal life, and vast changes are being brought about in our biotal [biotic] conditions. The old order is passing away, in many places has already passed, without leaving a record of its being behind. If the next generation is not to charge us with being indifferent to their interests we must improve every opportunity of making record of present conditions. The time for this work is now, for every day means some loss on the pages of our records that can never be filled."[58]

Ottawa in the year 1911 was a small city of about 50 000 people. Scenically it was very attractive, part of an area being built around three major rivers and their confluence — the Ottawa, Rideau and Gatineau rivers — as well as the Rideau Canal. Beyond it in the near distance looking northwest stands the low line of the Gatineau hills — in the winter showing grey or white — but in autumn a fiery background of orange and gold. The Rideau Canal, originally built to link the town of Kingston on the St. Lawrence River with Ottawa, gives distinction to the capital city with its neat locks and the trees and flowering shrubs lining its banks.[59]

But in the spring of 1911 Taverner was in no mood to appreciate the scenery; what he longed for was a home of his own in Ottawa.[60] After looking at the price of land, with his experience of building behind him, he decided to wait before buying a lot because prices were too inflated. As he reported to Fleming:

"You remember those lots we pass[ed] on the car by the Experimental Farm? They want $900 for a 50 foot lot way out there. They are opening three subdivisions all around the city and I cannot see that the city is growing to an appreciable extent … it looks to me like a Real Estate man's boom and prices will drop heavily soon."

Also, on account of his mother he was not prepared to buy on the outskirts of town where few conveniences as yet existed.

"After having a comfortable home it would be more or less like roughing it to her and it is hardly fair to ask her at her age to try and get along without the comforts she has been used to unless there are other very great advantages."[61]

By mid-July his mother and sister were with him in Ottawa; in August the sale of their Detroit house was completed and he began looking in earnest for a location in which to buy a lot. At this time they were living in a house immediately south of the canal near Bank Street and liked it so much that if they could find a lot in the area at a reasonable price they would buy there. As he explained to Fleming:

"It is really the prettiest part of the city in my estimation and the closeness of the canal water makes it desirable if one wants to do any boating."[62]

Fleming was anxious to know how Percy's mother liked living in Ottawa, especially since at first she was likely to feel lonely. To encourage them he said:

"I fancy once you get to know people you will all like it. There are more people of culture and intelligence in the civil service than are usually to be found in a city of Ottawa's size and consequently there are [people] interested in things other than money getting."[63]

The Taverners found a suitable lot near to where they were renting. He told Fleming:

"It is a small farm — 88 × 132 over near where we are now living. It has no trees on it but it is within sight of the canal and the beautiful elms at the end of the street form a vista half a block away. I have my plans all pencilled in and expect to start building as soon as I can get them finished and figured. All I fear now is that it will run high. If only I can build it as I have it drawn it will make a most comfortable and beautiful place …"[64]

It also promised to be a good location for birds on migration as Taverner told Fleming in October.

"Where we live are a fine lot of big elms and beeches just across the road and this fall they have been filled with birds of all kinds. A flock of Whitethroats [White-throated Sparrows] found that the rigs crushed the acorns that fell in the road at the side of the house and have been feeding there on them in great numbers."[65]

He also sent Fleming the plans he had drawn for the house, and a photo of the model he had made for it. Fleming's mother was somewhat critical saying that it looked like a Chinese pagoda, but Fleming offered several practical suggestions for improvements.[66]

Building started in 1912 and by early April the foundation was almost "up to grade". Percy described their excitement especially since it was his own design.

"We are all watching it with the greatest interest as likely you can imagine. Mother takes her first look in the morning and the last at night out of her window across country at the scaffolding that marks the concrete forms and can think of little else."[67]

Writing to Arthur Andrews, his entomological friend in Detroit, he said:

"Yes, we still like Ottawa immensely. There are a very nice lot of people here that take intelligent interest in things and can talk about something besides the last baseball game… Mother and Ida are delighted with the people and the place. Ida is right in a musical crowd and Mother is realizing the dream of her life and is studying French to beat the band."

However, Percy was not much impressed by the buildings in Ottawa.

"The city, too, is delightful, though architecturally rotten. We are right at the base of the Laurentian hills which rise just across the river and half an hour will take us right in the Canadian fauna while around to the south all is transition."

But building a house was not all smooth going.

"At present I am filled with the bitter-sweet pleasures of building a house for ourselves. It is lots of fun but lots of worry as well. We have had all kinds of trouble but at last things seem to be straightening out. They started laying brick above grade today after having to tear a great lot down to put a water-proof grade course in. We have a fine big lot 88 × 134 and are planning a garden that is a garden. We are only a block from the Rideau Canal…."[68]

Mrs. Fleming had been visiting Ottawa in the summer and reported an outbreak of typhoid fever. Fleming urged Percy to take precautions to which Percy replied:

"I take care of what I drink and eat. We use nothing but boiled water in our house for everything in connection with food, teeth cleaning etc., drink no water away from home unless we know that our hosts take the same precaution. Having done this much I see nothing else to do and try to forget that there is typhoid in the city."[69]

With museum work and house building Percy had very little time left for correspondence other than to Fleming. But in October he managed to type a long letter to Bradshaw Swales, pleading delays in building for not having written sooner to old friends. At last the house was finished and they had moved into it, though there was a lot of grading, filling and gardening to be done. He added a piece of family news. "Ida passed the Civil Service examinations and was installed here in the library of the museum."[70] With a convenient and attractive-looking house of their own Percy, his mother and sister settled down to enjoy their family life and get on with the next project — a really good garden. The only cloud was that the house cost more than estimated and Percy found

The Taverner house, 45 Leonard Avenue, with construction near completion in 1912. (Reproduced courtesy of the Canadian Museum of Nature, number 41307.

himself under financial strain finishing the payments on it. He had anticipated a raise in salary but when that was delayed he was only just able to make ends meet.[71] But Taverner was used to that problem.

Another problem which Taverner had been familiar with for some time was how to cram into each twenty-four hours all the activities to which he was committed. His appointment at the National Museum made him drive himself very hard. He was always "up to his eyes" in work. Before each year came to an end he had to begin preparing a report for that year, covering the zoology section, for printing in the Summary Report of the Geological Survey of Canada. In November 1913 he began writing his report for that year. He had now been wrestling with the problems of the section continuously for twenty months and could feel that he had achieved considerable progress. For Taverner the year 1913 was a year of systematization when a great part of the cataloguing and arranging of the old collections was completed and new projects started. Particularly important to him were the people he was working with. At the top was Reginald Brock, director of the museum. Taverner had already expressed some frustration over what he considered Brock's lack of forcefulness. Now he complained to Fleming of Brock's lack of communication with the representatives of the various divisions serving on the recently formed museum committee. But his good qualities outweighed his weaknesses. Taverner criticized Brock's handling of a stalemate among the members of the museum committee over the format and the names of museum publications. But then he wrote:

> "The more I see of Mr. Brock the better I like him though I think it would work for much more satisfaction should he [let us] in on his intentions a little more."[72]

Taverner was not diffident in writing a letter to Brock when he wanted something, or had an idea for improving some aspect of the museum. For instance he asked for the occasional use of a stenographer. Brock sent back his letter with a hastily scribbled note on it that the museum had provided in the estimates for permanent stenographers. Late in 1913 Winifred Bentley was transferred to the zoology section as assistant and typist.[73] In another letter to Brock on the same day Taverner raised the question of the name of the museum in a nice piece of Taverneresque logic. He suggested that in future less stress should be put on the title of Victoria Memorial Museum.

"As I understand it that name applies only to the building we are in and means no more than the 'Jones Block' does to a law firm having offices in it."

He argued that it was an unfortunate choice of name since there were two other museums for which it could be mistaken, one in British Columbia and one in Australia. He suggested that authority should be obtained for using the name Canadian National Museum which would be more appealing to the national spirit of Canada. He concluded:

"The inaptness of our present… name is obvious if we consider what would happen if we were moved to another building, then what would we be?"[74]

Brock wrote on the letter "Good suggestion bring it up at museum committee", and returned it to Taverner. The name was not changed until 1927. Another letter he wrote to Brock at this time was about his salary. He said that he understood at the initial meeting before he was appointed that it was lack of actual museum experience that caused his starting salary to be placed at $1600.00 instead of $2100.00.

"I think I have shown that in spite of having never been formally engaged in museum work I understand its practical requirements fully as well as though I had and that this objection is therefore removed."[75]

Brock could not know how strapped for money Taverner was at this time. His salary increased in the following year when he was promoted in rank.

Other matters on which Taverner reported to Brock as his superior were: A request from Maxwell Graham, Chief of Animals Division, Parks Branch, for his opinion on the introduction of English song birds into Canadian National Parks.[76] A request from James Harkin, Commissioner of Dominion Parks, for his written opinion showing reasons for establishing wild animal sanctuaries.[77] He also reported to Brock regularly on loans of study specimens made to other institutions or individual collectors of good standing. In the case of making permanent exchanges of bird specimens between the National Museum and another institution or individual he would make a recommendation to Brock.[78] Such exchanges were quite regularly made by museums in order to add to their collections, particularly concerning specimens they lacked. It worked well so long as the judgment of the curator responsible was always sound, and one's own museum always got a fair exchange. The reason for sending a recommendation to a senior authority was to keep a check on the proper working of the system rather than to obtain his advice, since only the head of a department was in a position to estimate whether a particular exchange would be to the advantage of his own museum or not.

Another of Taverner's colleagues was Jim Macoun, acting head of the botany section. They appear to have got on well together in spite of Macoun's dislike of Brock. The correspondence which has survived between the two men was mainly about botanical matters.[79] A member of the zoological division with whom Taverner was on good terms was C. H. Young the taxidermist, mainly responsible for preparation of invertebrate material (hence his nickname "Bugs" Young) and a willing worker who produced highgrade results. They worked together during Taverner's first field trip in 1913 (see Chapter 8). The only other member of the museum staff whom Taverner appears to have respected was Harland Smith of the archaeology section of the Division of Anthropology.

The year 1913 was an important one for Taverner's future career because it was then that two long associations began that were to continue throughout his professional life. In the spring of 1913 Clyde L. Patch was appointed taxidermist in zoological preparatory work at the museum and was to work with Taverner until the latter's retirement. Also in the spring of 1913 Rudolph M. Anderson first began to impinge on Taverner's life when he was appointed to the museum as mammalogist. When Taverner first heard that Anderson was going with Vilhjalmur Stefansson to the Arctic again he wrote to Brock about the possibility of getting Anderson a museum appointment. Brock had already written to the Minister of the Interior and the Prime Minister recommending that the government contribute $25 000 and that Canada should participate to some extent in the expedition. The government decided that Canada should sponsor the expedition exclusively, and as a result Anderson was appointed.[80] In reporting this promising turn of events Taverner grew quite eloquent in a letter to Fleming.

"Anderson got a most remarkably fine lot of stuff last year with Stephenson [Stefansson], as an example 19 bears and over 900 bird skins. As it was entirely a foot expedition there is no knowing what he can do on this occasion with an annual ship to work from. Anderson will be more stationary than Stephenson and will work more about the base and have more facility for storing and caring for stuff. I understand that he makes up beautiful specimens. He has had some Museum experience in Kansas. He is the man that wrote The Birds of Iowa in 1907, but is preparing to specialize on mammals. Personally I understand from Brock he is a most delightful fellow. B. says he is quite taken with him and has been making extensive inquiries as to his ability with most satisfactory results."[81]

Taverner was very anxious to have a mammalogist appointed who would take the responsibility for the mammal collection off his shoulders. He had not been trained or appointed to preserve and display mammals; the care and development of the bird collection was ample work for one man. The only drawback about Anderson's appointment was that he would not be available to start work in the museum for an indefinite time because he would be exploring and collecting in the Arctic.

Taverner, meanwhile, was looking for opportunities to fill the large number of gaps in the museum's

Victoria Memorial Museum Building, about 1913. Viewed from the northwest looking past the building toward Elgin Street in background. The massive main entrance tower, on the north side, was subsequently removed after it started to tilt and sink into the underlying clay. (Public Archives of Canada photo 9273, print courtesy of the Canadian Museum of Nature.)

collection. He required species, and subspecies, not already represented in the collection in order to be able to work out the range of the subspecies. Also he needed series of various plumages, such as breeding and intermediate plumages, male and female, and if possible, between various juvenile plumages.[82]

One piece of luck that came Taverner's way was when Fleming presented the museum with a collection of 350 birds, most of them mounted, but some study skins. In his Summary Report for 1913 Taverner noted that the workmanship on the mounted birds of the Fleming gift was especially good, while the collection included some rare species and some type specimens. He also pointed out that it was "particularly gratifying to receive such a valuable gift from a private individual, for it is through the interest and beneficence of public-spirited citizens, only, that a national museum can attain greatness and importance." Another point of importance was that the gift was made without conditions "so that for all time the curators will be free to make the most valuable use possible of the material." Conditions, Taverner pointed out, change during the course of time and restrictions accompanying a gift, however wise they appear at the time, may in the long run prevent it from being used for as long as it might have been, had it been given without strings attached. "Mr. Fleming, with his knowledge of museums and museum work, has made no such mistake."[83]

Other additions came through purchase, and by collection in a summer field trip to Point Pelee (Chapter 8). Two mounted Passenger Pigeons were bought, one of them from the Toronto taxidermist H. H. Mitchell for $50.[84] Another purchase was made from a private fur trader, Clement Lewis of Whitehorse, Yukon Territory, of 211 birds and 380 mammals from the Teslin Lake region near the Yukon-British Columbia boundary.[85] What pleased Taverner especially about this collection was that it included several specimens of Blue Grouse collected in October 1912. When compared with the two subspecies recognized as ranging into Canadian territory

they were seen to be somewhat different. This gave Taverner the opportunity to attempt to establish a hitherto unknown subspecies of Blue Grouse by a very detailed description of plumages. These birds were smaller and darker than Richardson's Grouse [Blue Grouse] which they most resembled. After borrowing summer and autumn specimens of Richardson's Grouse from the U.S. Biological Survey for comparisons Taverner wrote a description of the Teslin Lake birds as a new subspecies of Blue Grouse, from Southern Yukon Territory. He named it *Dendragapus obscurus flemingi* after J. H. Fleming "in recognition of the value of his ornithological work in Canada."[86] The proposal was accepted by the AOU and published in *The Auk* thus giving it the stamp of authority. This is an example of Taverner carrying out his duty as curator of the bird collection at the National Museum at the highest level of ornithology by determining whether any of the specimens under his care were viable new subspecies hitherto unrecognized as such. This particular subspecies lasted a reasonable length of time and then was "knocked out of the list" when the AOU Committee on Classification and Nomenclature carried out a purge of some of the Blue Grouse subspecies by lumping them into two only.[87] Possibilities for acquiring new specimens for the museum were liable to occur quite unexpectedly as when the professor of botany at Queen's University called to see him. Taverner learned that Queen's had some of the birds brought back by Robert Bell from his Hudson Bay expedition.

In addition to building up the bird and mammal collections Taverner was anxious to make the zoology section attractive to visitors and of value to the public educationally. At the same time as he gave a collection of birds to the National Museum, Fleming deposited, on loan, a number of mammals including the only two Ontario-killed cougars known to exist. Another specimen of popular interest was a wolf, one of the original wolf pack made famous by Ernest Thompson Seton in his story "Lobo, King of the Corrumpaw". Writing to Fleming about the loan he said: "I should much like the wolf for popular exhibition. Anyone who has read the King of the Corrumpaw will be interested in it and I would like to make the Museum interesting from as many standpoints as possible."[88] In the same letter he mentioned that the museum estimates were on the way to being passed and that $25 000 was being included for the bird range rooms and their cases. "The Dept. of Public Works hope to have it ready by July. Things do move though Government work is like the mills of the gods."[89]

Taverner was becoming more sure of himself as a museum man by now. In spite of continual delays and difficulties he had already achieved a state of order and had something to show for his efforts. His nature had not changed in spite of a permanent salary. There was no slackening off. If anything he was working harder than ever and enjoying it, and even finding time to take on extra work in addition to the museum by making an ambitious garden. In May he wrote to Fleming: "Ida has her typewriter at home writing me a set of specifications for a house I am planning for one of the members of the Survey and I am taking advantage of it to get off some pressing correspondence."[90] He must have been under pressure, and the message he was sending his friends was "I am desperately busy". He used two different expressions on the same day to depict his state of busy-ness. To Brad Swales he wrote he was "as busy as the Devil in a gale of wind", while to Fleming he said "I am chasing around like a chicken with its head off."[91] But that was his style. He had the bit between his teeth and was galloping with it.

By the beginning of 1914 Taverner had been responsible for the development of zoology at the museum for two years and eight months. He had come through a difficult and frustrating time, had survived the challenge, and was now on the way to achieving some of the immediate goals he had set himself. But the conditions necessary in order to carry out his long-term plans for the expansion of the zoological collections depended on circumstances outside of his control. These included more museum space for research and display, more members of staff, and congenial colleagues to work with. Taverner might reasonably have expected that the year 1914 would be a good year for him now that things were running reasonably well in the ornithology section. But life is unpredictable. The year started with a personal setback for Percy and ended with a catastrophe for humankind.

On Tuesday 13 January 1914 the temperature in Ottawa fell a long way below zero Fahrenheit. Furnaces were stoked up to keep pace with the bitter cold. Number 45 Leonard Avenue caught on fire. Percy turned to Fleming for advice. "Just a line. Was burned out Tuesday and am in a peck of trouble now with the adjusters... The house is a bad wreck, but all walls are standing, most of the roof intact, floor weakened and the wood work thoroughly ruined, but if I get any justice from Insurance Co. hope to be in old home again by May." His house, he said, had cost $4700.00 and was insured for $5000.00. The furniture was insured for $1000.00 which would hardly cover the loss if the damage to the piano, which Ida played, was considerable. Percy was afraid that he might have to put matters in the hands of a lawyer and asked Fleming for his advice. He assured Fleming that he had sufficient financial resources for the present and that the holder of their mortgage, Dr. Saunders, was lenient and helpful.[92] Fortunately his bird books and other things were in the museum but it meant that he and his family had to take a furnished house nearby until rebuilding was

Early exhibit hall and visiting public at the Victoria Memorial Museum, 1912. (Reproduced courtesy of the Canadian Museum of Nature, number 22217.)

finished.[93] The insurance claim was settled satisfactorily in February.

Taverner had better luck over his own position at the museum. In a letter to Brock, written in March 1914, he noted that his appointment to the museum staff read "Preparator and Assistant Curator". The first term was a misnomer and he asked that this be altered to "Ornithologist". As he pointed out: "My work is chiefly ornithological and I regard my present direct oversight of other branches, except perhaps general exhibition, but temporary until competent experts can be appointed to assume their charge."[94] R. M. Anderson was appointed mammalogist in 1913 though he did not start his work in the museum until early 1917. Another matter that Taverner was anxious to have put right concerned his salary. He had written to Brock in January 1913 asking him to consider promoting him. (See above.) In August, Brock notified him he had been promoted to subdivision B of the first division.[95]

By 1914 a major problem, which had been growing since the collections were first displayed and properly stored in the new museum, came to a head. The problem was one of space, but this in turn grew out of a problem of organization. The Victoria Memorial Museum was originally built to house the collections of the Geological Survey, and was part of the Survey rather than an entirely independent body as most museums are. The museum director was always a geologist. This was a flaw in organization and administration from the beginning. It suffered from a "geological fault". It was natural, therefore, that when the new building was being occupied in the period 1910-1911 members of the drafting and topographical staff also moved in, though their duties had nothing to do with museum work. However, they and their field equipment took up essential space. The museum committee had drawn attention to this situation in a memorandum to Brock in July 1912 but without success. A second memorandum was sent to the new Deputy Minister of Mines in October 1914. It was a strong indictment of the misuse of essential space required for museum work by the inclusion of the drafting and topographical staffs in the building. The memorandum reported that the west wing hall on the ground floor was being used by these staffs as a freight shed and storage room for tents and other field equipment. No valid

reason existed for its continued occupation in this manner. On the third floor the whole west wing hall was occupied as a drafting room. The memorandum described the overcrowded conditions in the basement and the other three floors, as well as a litany of the deteriorating condition of specimens in the seven sections of the Biological and Anthropological Divisions crowded into the museum. The committee warned that valuable materials were becoming more and more inaccessible for want of space. The condition was rapidly approaching in which it would no longer be feasible to take advantage of opportunities to secure specimens of value when offered. The document concluded with the hope that those members of the Geological Survey whose duties had no part in operating the museum would be removed and the way cleared for the rearrangement of working space for museum purposes. The final paragraph opened up broader problems when the writers stated their conviction that "under proper guidance and with a freedom of action which it has not as yet experienced the museum will rapidly assume the place amongst Institutions of its kind which the people of this country intend it to occupy."[96] The words "proper guidance and freedom of action" pointed to problems from which the museum was to suffer during the rest of Taverner's lifetime.

As though this problem was not enough, in August 1914 Brock suddenly resigned. He had been treated somewhat badly by the administration over his position. He had accepted the post of acting deputy minister in November 1908 on the understanding that when Low was no longer able to carry out the duties of Deputy Minister of Mines he would be appointed in Low's place. But even when it was clear that Low had become too ill to perform his duties he was still retained in the position year after year while Brock continued to carry out the duties of deputy minister without salary for the post. Not until January 1914 was Low retired on pension and Brock became Deputy Minister of Mines. The long battle to obtain sufficient space, equipment and supplies for the new museum, as it grew, probably made Brock tired of government administration and glad to become the dean of the Faculty of Applied Science at the newly founded University of British Columbia. He was replaced by R. G. McConnell, a well known geologist with long service in the Geological Survey. He was fifty-seven years old at the time of his appointment and he served as deputy minister until his retirement in 1921. Taverner had got used to Brock and could work with him, and found him supportive and reasonable, though he criticized Brock's policy which, he wrote, "was to throw everyone in together and let them all find their own level."[97] Taverner now had to get used to working under a less dynamic director of the museum. In wartime, as Taverner and his colleagues in the museum were to find, government finances were minimal. The museum was still an offshoot of the Geological Survey rather than an independent institution in its own right.

Not all Taverner's time was spent inside the museum working on administration and studying bird specimens. To members of a museum staff, after long months cooped up within the walls of their "mausoleum", the precious weeks or months spent in the field collecting specimens and artifacts came with a sharp sense of release. Taverner's first field trip took place at Point Pelee in 1913 (mid-May to mid-July) and must have given him the same kind of feeling of escape from indoor routine, as well as challenge from the job awaiting him and his associates in the wide outdoors. (See Chapter 8, devoted to the collecting trips undertaken by Taverner and his staff, and by professional collectors working for the museum, in the period 1913-1919.)

Evidence which Taverner saw for himself while at Pelee made him strongly aware of the danger to birds from commercial hunting and by loss of suitable habitat. From late 1913 Taverner became seriously involved in a problem which was to concern him for the rest of his life — the urgent need for conservation (see Chapter 9).

A further addition was made to the permanent staff of the zoological division in May 1914 when Claude Johnson became colourist in the preparation department. His main work was making coloured illustrations of mammals and painting backgrounds for habitat groups.[98] Meanwhile, new specimens were regularly being acquired by purchase, often as a result of information from Fleming who was continually skimming through bird dealers' catalogues. For instance Fleming wrote:

> "Wards of Rochester were offering a California Condor for $35.00 recently and it seems to me we will have to include this bird in the Canadian list. It might be advisable if the skin is a decent one to get it if you felt you want to eventually have a complete Canadian collection. I paid more than this for one in England last November and this is the fourth one I have seen for sale in 20 years. They are hard to get."[99]

Fleming also located another Passenger Pigeon being offered for sale by a private owner in Toronto, and notified Taverner who acquired it for the museum for $25.00.[100] Taverner acknowledged Fleming's help in his 1914 report for the zoology division.

> "Among the most notable of the accessions is one composed of some 113 specimens, obtained by purchase. This consists largely of extra-limital material of peculiar interest to Canadian ornithology such as European and southern types of forms allied to Canadian varieties. In obtaining these we are grateful to Mr. J. H. Fleming, whose active efforts and advice were of great assistance to us in selecting them."[101]

At last the cases Taverner needed so urgently were being delivered; six new ones for the storage of birds and small mammals, and three cases adapted to zoological exhibition. Ornithological work

continued in the collections with the birds being determined in their systematic order. Taverner obtained help from eminent ornithologists in the United States such as H. C. Oberholser and J. Dwight as well as Fleming and Brooks in Canada. But his lack of identified specimens for comparison held up the work considerably. For instance, when working on the Great Horned Owls Taverner came to the conclusion that there were probably three "good" (reliable) forms in Canada: a white one, a black one and an Ontario one. As he told Fleming,

> "Here is where it seems impossible to do much without comparable and identified specimens. In size there is not over half an inch difference in any of our specimens except the white Manitoba birds which are small. My opinions on our geographical races is growing more fixed than ever."[102]

What Taverner means, I think, is that he is beginning to find confirmation of what geographical races occur in Canada, not that he has closed his mind to any further evidence. This is a continual theme running through his letters with Fleming and Bishop and with other ornithological correspondents — the danger of accepting subspecies on other people's determinations without examining them critically. To Fleming he wrote:

> "I do not think there is any question of Oberholser's earnestness nor of his ability. It is only a question as to how far the sub-division should be carried. It is a question of degree and I think he goes too far."[103]

But from this we should not infer that Taverner, Fleming and several others were personally hostile to Oberholser and others who made subspecific determinations rather often. Taverner and Oberholser wrote to each other, loaned specimens to each other's institutions for study, and talked when they met each other. Ornithologists belonged to an international community in which exchange of information was a recognized courtesy. Independence of mind and responsible criticism of colleagues was accepted as necessary to keep ornithology in a healthy state.

If anyone had told Percy Taverner four years previously that in 1914 he would be established as ornithologist at the National Museum of Canada, extremely busy running his own department with exciting opportunities for field studies, he would not have dared to believe him. The frustration at having to earn his living at work that was uncongenial was a thing of the past. He said so openly in a letter to an acquaintance of his bird-banding days, J. Leon Cole, who had written thanking him for a separate which Percy had sent him, and asking about his job. Percy replied:

> "Of course my principle work is ornithology and I find it a great relief to do one's chosen work as a livelihood instead of sandwiched in between the grind of pot-boiling. Being head of a division, building up a National Institution is in many respects an enviable one and I appreciate it."[104]

## CHAPTER 7. Museum Problems (1915-1919)

In the spring of 1915 an article by Taverner entitled "Suggestions for Ornithological Work in Canada" was published in *The Ottawa Naturalist*.[1] It was a manifesto of ornithology in Canada at that time and Taverner explained what needed to be done, and the kinds of studies that amateurs could usefully undertake. Taverner started by showing some of the main gaps in our knowledge of ornithology in Canada. Our information on the geographical distribution of birds in Canada was fragmentary, as he showed, while hardly a typical Canadian species had been studied as the subject of a life history. So much needed to be done that ornithology offered a fine field for original research. The southern peninsula of Ontario was perhaps the only area of any size that had received adequate attention. Very little was known about the bird situation in the area from northwest of Georgian Bay to the Manitoba boundary, while there was only scattered information of conditions in the far north, often consisting of no more than short lists of birds. Very little original work had been done on the role of birds in the economy of the country. Study collections in Canada were too small to permit anything comparable to work done in the U. S. to be accomplished in the study of Canadian birds. In addition, Canada lacked trained zoologists.

> "Thus, it seems that ornithology in Canada still has most of its history before it . . . the work that should have been done by our own people has been accomplished by naturalists from the United States . . ."[2]

Taverner noted an apparent failure to produce any ornithologists of marked ability in spite of the teaching of natural history in every public school in Canada. He believed that an introduction to nature in the schools "had failed to awaken any serious interest in natural problems." But he remained optimistic that now, when museums were being started or rejuvenated in various provinces, "the time seems ripe for a general wakening of interests in zoological subjects".[3]

In order to stimulate interest in field studies Taverner suggested two main subjects that needed regular study. They were:

1. *Life histories.* These could be compiled by stalking birds with a camera and notebook in order to study their behaviour. Valuable information could be gathered by watching birds around one's own home. This was something that was both interesting and enjoyable. People with more leisure and opportunities might wish to study less common species farther afield. By way of suggestions for further investigations Taverner listed twenty six specific questions including: *migration* — is the species resident or migrant? Dates of arrival and departure. *Courtship*

*nest building*, brooding and chick rearing — how is this carried out? By one or both birds? How were eggs and chicks protected?[4] The list of questions can be expanded into many other aspects of a bird's life history.

2. *Bird distribution.* At present, Taverner said, the published ranges of birds in Canada "are based upon geographic probabilities, *a priori* reasoning or are copies and recopied, from previous writers."[5] For example, lists of southern Canadian birds gave the Hairy Woodpecker, rather than the Downy Woodpecker, as the common form, where he considered it a rare winter visitor. In order to establish the Canadian ranges of our birds, Taverner said, we need skilled observers at all possible points to collect local data and specimens. There ought to be an observer and a collection in every county, someone who was keeping track of his own area and comparing and checking it with the results from adjoining stations. Provincial museums should collect local details, and all the information should then be correlated at the National Museum. "In this way we would have cooperation and series of local collections illustrating intensive work throughout the Dominion."[6] But, Taverner warned, all such work, to be of use, must be based on exact personal knowledge and substantiated in every way possible — there must be data by which to check the statements made. The local observer should study the bird life of his chosen locality thoroughly. This would involve searching old literature and compiling a local bibliography. He should connect every record with a fully confirmed specimen, either in his own collection, or else note where one is located. In determining a specimen he should refer to those with greater experience if he is at all uncertain.

> "In fact, to a local faunal list it is better to add a hypothetical list for all species whose occurrence cannot be substantiated by specimens or on equally unimpeachable evidence. A long hypothetical list is often an indication of careful work rather than the contrary."[7]

As regards collecting specimens, the student of a locality should attempt to gather a representative series of all birds of the area showing every plumage in which they occur there. Single individuals or even pairs are not enough, nor is one example of each stage sufficient. "It is only by a series of several that the average can be established." Even aberrations such as albino or melanistic specimens are of limited general scientific interest, "the normal is a much more desirable subject of study".[8] As a good source of information on specific occurrences the local taxidermist is someone to cultivate, not only to secure specimens but also to see what passes through his hands. It is also worth keeping in touch with the shooting and sporting fraternity. The best way to keep a collection is as dry skins rather than stuffed and mounted. Since the object is the indefinite preservation of the specimens, with the least deterioration, skins are much preferable. The effects of dust and light, as well as insects on mounted specimens are very destructive, thus making their life a limited one. Since specimens need to be examined closely in a good light and compared with each other, properly made skins are the answer.

At this point Taverner discussed the vexed question of subspecies and how far it is desirable to study them, and the current system of nomenclature. He explained the reason for studying subspecies; that species were not permanently fixed, that geographical variations do occur, the extremes of which show considerable differences when compared with the type specimen. Since various stages of differentiation (intergrades) between the "norm" of a species and examples of extreme variations exist, this seems to indicate that these are evolutionary variations, and should therefore be regarded as "species in the making before the connecting sequence between them and the parent stock has been disrupted or broken down to form isolated species."[9]

He then explained the scientific method of naming birds — one term for the genus to which it belongs and another for the species. But since it seemed useful to give supplementary names (cognomens) to geographical variants to distinguish them from the typical form a third name was added. After discussing the method of naming the species with two names (binomial) and the subspecies with three names (trinomial) he then stated his own view.

> "It is . . . only necessary to name subspecies . . . where special exactness is required by context or scope of consideration. Subspecific designation should only be based upon examinations and authoritative determination of specimens, and not upon probabilities or assumptions."[10]

Taverner considered that, although in theory innumerable subspecies of a widely varying race must exist, "most of them are too fine for human recognition."[11]

In the light of his strongly expressed views on the question of naming new subspecies Taverner summed up his position at this time in a conciliatory way. The question, he said, was not whether to make new subspecies or not, but *where to draw the line* [emphasis added]. Whether it is in the best interests of science to name variations that only an expert, especially trained, can recognize is still to be argued. However, whether we agree with the position of the "splitters" or "lumpers" it seems best for the majority to follow the lead of the American Ornithologists' Union. "However, for the sake of uniformity it is better to err on the conventional rather than the radical side and to keep as largely as possible in harmony with accepted contemporary authorities."[12]

On the controversial issue of whether or not naturalists should ever shoot birds Taverner set down the axiom that "no enduring faunal work can be accomplished without the collection of specimens". He argued that collecting was a necessary evil but that

due regard must be given to humane principles; that a permit to collect specimens was a privilege, and that specimens once taken should be regarded as a kind of public trust. They should be kept safe from damage, made available for study by others, "and finally placed in some known repository where they will be available for coming generations of investigators."[13] He disagreed with the fear that legitimate collecting would deplete Canadian bird life and argued that the millinery trade caused far greater destruction of birds in one year than all the collections made in North America during the past fifty years had done. Taverner also dealt with the feeling against scientists collecting "rare birds" on the assumption that if they were allowed to breed they would become more common. But this, he said, was not proved. Birds become rare from other, more pervasive, causes. He pointed to the extinction of the Passenger Pigeon and cited the example of netting the birds in the trees of the Petoskey breeding "rookeries" in Michigan. In the autumn of 1878 the birds left on their usual migration in large numbers, but few returned the following spring as if some calamity had hit them in their wintering range.[14]

At the end of his "Suggestions for Ornithological Work" Taverner returned to the wish that the provinces would establish museums that would develop into repositories for provincial data.

> "In the meantime we have a Dominion Museum that is prepared not only to store but to scientifically use such material and is slowly building up a national collection for future Canadian students in proportion with the growing dignity of the country it represents. It is to be hoped that the time will come when it will take equal rank with other national museums of the world, the British Museum, the Smithsonian Institute and others of like repute. To do so, however, requires the co-operation and sympathy of the Canadian people as a whole. No public institution can do all the necessary work itself but must rely largely in the building up of its collections and prestige upon the interest and aid of the people it represents."[15]

Taverner's manifesto is important for the light it sheds on his own attitude towards ornithological needs and problems facing him in 1915. We should not judge it by our knowledge and attitudes of today but view it in the light of the problems which faced him as ornithologist at the newly evolving National Museum of Canada. It is here that we can read Taverner's principles most clearly expressed. His "manifesto" marks a step forward in his career, and shows him beginning to demonstrate leadership at the national level.

In the spring of 1915 Taverner was thinking seriously about writing a book. He asked Fleming for advice on a plan he had worked out for a popular bird guide which might have for title "A century of common Canadian birds". It would be limited to birds of the provinces east of the Prairies. Fleming replied that he thought the plan was excellent and sent him some helpful suggestions.[16] From early 1915, until the book was published in late 1919, correspondence continued between the two friends on the subject. The writing of his first bird book was a major step forward for Taverner. It increased his knowledge of ornithology in Canada and his understanding of the problem of how to present it to the public. It also increased his self-confidence while making him better known.

Taverner must have been very busy during the winter of 1914-1915 because early in 1915 he presented his "Recommendations for the creation of three new national parks in Canada" in a report to the Canadian Commission of Conservation. He also wrote up his investigations of 1914 on the economic status of the Double-crested Cormorant in the Gulf of the St. Lawrence. With these reports Taverner assumed an important role in the growing Canadian awareness of the urgent need to protect wildlife in specific habitats (see Chapter 9).

Meanwhile field work, begun the previous year at the Gaspé Peninsula, was continued there in 1915 by Taverner together with Young, Patch and Johnson (see Chapter 8). The trip lasted nearly two months and Taverner was faced with plenty that needed his attention at the museum. He told Fleming,

> "Back again and very busy clearing decks to get at the bird book and Gulf of St. Lawrence report. Had a delightful trip not many specimens but got a good bird's-eye-view of the country and some fine moving pictures and ordinary photographs of the Bonaventure birds".[17]

Taverner kept a carbon copy of every letter about museum matters that he sent to friends. But now that Miss Bentley was working in the department he would have to be careful what he wrote, or else keep his letters locked up. For instance, writing to Fleming he mentioned Patch.

> "Patch is still in Perce. Evidently he enjoys being left alone, and head of his camp. He is a queer fellow and hard to get along with. Johnson, his assistant, however, is a fine camp mate and a good fellow."[18]

Fleming warned him to be very careful what he said in his letters if Miss Bentley could read them.[19] Percy saw the humour of his remark and replied in a P.S. to his next letter to Fleming:

> "Miss Bentley not only can read your letters but she can read mine as well — that is going some."[20]

Taverner's handwriting was moderately legible but Fleming's was more difficult to read because many words seemed as if written in a private form of shorthand.

Several other ornithological problems and matters occurred during this period. For instance Taverner's work on determining species continued, this time on gulls and geese. He turned to Fleming for help again.

> "If you can separate California and Herring Gulls, let me into your secret. I am all at sea over them. I do wish also some one would tell me what a Hutchin's Goose is. Everyone has a different theory; none of which work out

the same with our stuff. Though they say that in life the birds are absolutely distinct."[21]

Fleming invited him to come to Toronto for help in identifying specimens and for advice on the colour and make up of his book.[22] Because the National Museum did not have sufficient series of bird specimens for all the comparisons that Taverner needed for scientific determinations he relied much on the collections of his friends, among which those of Fleming and Brooks were outstanding in Canada. Anything that affected their collections affected Taverner. A passage in a letter from Fleming at this period must, therefore, have interested him.

> "I am still considering the future of my collection. I hope I am only 1/2 way through as to size. About 40,000 is what I have in mind. I would like to extend my American collection much faster than I am but two years more will mean little additional material and after that I may be so handicapped financially that I will have to forgo new material. However, let us hope for the best, and I believe the chances of getting material are likely to be good after the war. As far as the museum [the Royal Ontario Museum] is concerned I look forward to seeing it get past a purely Canadian field and well established in general natural history. I would feel much easier about the destiny of my collection."[23]

Because the National Museum was aiming to form a strong collection of the birds of Canada only and not of North America or the world, Fleming's collection was likely to be given to the Royal Ontario Museum. Taverner could hardly expect only the Canadian material in the Fleming collection to come to the National Museum. Matters were different with the Brooks collection. In June 1915 Fleming had visited Brooks's home in the Okanagan Valley on his way back from the AOU meeting in San Francisco, while staying with Munro. Brooks had left in a hurry at the outbreak of war and Munro was doing all he could to keep his bird collection from being infested by dermestid beetles, but had run out of napthol. Fleming asked for help.[24] Taverner replied that he would send some naptholin [napthol] to Munro, and added:

> "Brooks has arranged that his specimens come to our museum when he dies so that gives me an excuse for supplying a presentation from museum stores."[25]

Taverner should have remembered such popular sayings as not counting your chickens before they are hatched when he wrote those words. If Brooks had been killed during the war then certainly his collection would have gone to Ottawa. But instead he had a distinguished career in the course of which he not only won a D.S.O. but also survived active service in France. He continued to live almost as long as Percy and had ample time in which to change his mind about which institutions would finally receive his collections of birds and paintings.[26]

Also from around this period Taverner began developing a wider group of correspondents with similar interests to his own. One such was Henry Mousley of Quebec Province. Mousley had emigrated from Britain to Canada in 1910 and was soon studying the natural history of the area around Hatley in the Eastern Townships of Quebec. Here he began his extended field studies on the nesting behaviour of birds, especially warblers. Taverner heard of these studies when Mousley wrote to the Macouns about the *Catalogue of Canadian Birds* and mentioned his own observations over the past years. By late 1914 Taverner had started collecting data for his projected work on the birds of Eastern Canada, and when Mousley's letter was sent to him to answer he took the opportunity to request from Mousley any ornithological notes he might have. Taverner said, in part:

> "As soon as a reasonably complete reconnaissance has been made I intend publishing the whole results for the Eastern provinces. In the meantime we greatly feel the lack of other workers for the field is broad and we cannot cover it all in anything like a complete manner."[27]

Mousley responded with a copy of his notes on 110 species of birds found in the locality of Hatley. Taverner acknowledged this with thanks, at the same time apologizing for his slowness in replying.

> "Do not think that this seeming neglect is a measure of our interest in your work. It is but the result of covering a large field with a limited staff. Such lists as you sent are of great value to us and will be [of] inestimable value when we come to work out our distribution again."[28]

Taverner's use of the word "we" does not mean that he had suddenly assumed the royal "we" but simply that in 1914 he hoped that Brooks, Saunders and Fleming might be co-authors of the book with him. Writing to Fleming about Mousley's work Taverner reported:

> "Have been corresponding with an H. Mousley of Hatley, P.Q. He seems quite a find, and reports numbers of warblers breeding and evidently knows what he is talking about. He is giving us a [Northern] Parula nest and promises us more of like stuff".[29]

So began a fruitful correspondence between Mousley and Taverner which continued for a quarter of a century.

With all this activity and writing Taverner began to prove himself in his post as the only professional ornithologist in Canada. But he was never allowed to develop a swollen head, even if he had been that kind of person, because Fleming was ready to poke fun at him gently as when he wrote:

> "You ought to keep notes of your work as you go along a sort of journal would be the thing. I don't mean your field journal but something like lawyers keep. Mr. So and So telephone 50¢. There are so many things you do in the course of your work that you forget."[30]

However, Fleming also told Taverner that during the return journey from his trip to the AOU Conference at San Francisco he had visited Macoun in Victoria. "He talked about you quite a lot is very proud of your success."[31] Macoun himself wrote to Taverner: "I am very glad to hear how well you are

getting along and pleased to know that my work was not in vain."[32] The professor need not have worried. Taverner had made the grade.

Early in 1916 another fire affected Taverner's life. This time it was not his home but the Parliament buildings. His eye-witness description of the results of the fire on the museum building are worth quoting.

"A cyclone has struck us. The fire that burned out Parliament was almost as bad to us. Any way it spread desolation and disaster our way. Fortunately I have not been moved but the exhibition and office floors had to be vacated. We tore out the big cases and piled them up as best we could. Thank goodness though the study collections have not been disturbed and I suffered less than perhaps any one else. The Invertebrate paleontologists got hit hard and for two days and nights all the girls in the building and half the Geological staff were wrapping up specimens and packing them in boxes from the old exhibition cases on the first floor. I guess they lost a lot of stuff through breakage and unskilled handling. It was awful."

The fire occurred during the night of 3-4 February 1916, destroying the Centre Block of Parliament. The Commons started moving into the museum immediately, followed by the Senate a few days later. Not all staff were moved out of the museum. James Macoun, who had known the Director of the museum, McConnell, for over thirty years, persuaded him that the Biological Division would need more time to prepare for moving. But the presence of Parliament in the building was disturbing and in some ways members of the Division were better off when they moved into a place of their own in January 1918.[33]

Taverner's main work during 1916 was involved with his bird book. Because he was working hard to complete a draft of the manuscript he decided not to make a field trip himself that year. As a result he had more time for going through the collections and determining the species. His correspondence with Louis B. Bishop in 1916 contains interesting letters between the two men on various species and the loans of various skins. These letters, written in a relaxed style, show examples of Taverner's ornithological work at that time. Writing to Bishop in July he said:

"Dwight was here a short while ago. Our series of gulls rather surprised him as well it might. I think we have all the puzzles in the country, and to see practically the genus *Larus* linked together by apparent intermediates is enough to stagger one. These birds, especially the white-winged ones need study. When Anderson comes back this fall from the Arctic and brings the remainder of specimens I guess it is up to us to get busy on them."[34]

It seems that Taverner lightened the burden of some of his regular and lengthy correspondence by repeating passages used in a letter to one friend in a letter written soon after to another friend. Thus material in the letter to Bishop quoted above had already been written, in part, in a letter to Fleming as follows:

"Dwight was here yesterday. I think he was surprised at the extent of our collections. He went over the Horned Larks and several other species and the very forms I had failed to find he regards as untenable. His ideas on them cleared up a lot of my difficulties. I was glad to have him corroborate my identifications of Wright's and Hammond's Flycatchers that I was pretty shaky on. I sweated on them but could not work out the wing formula at all."

In the same letter he mentioned the gulls known to occur in Canada, but in somewhat different wording.

"Dwight looked over the gulls and is just as puzzled as I am. An intergrading of the California Gull through Kumlien's to the Iceland taking in the Glaucous by the way and connecting with the Herring Gull is enough to cause thought. It must have some reasonable explanation but the above is the superficial appearance."[35]

A study of the taxonomy of many species of birds found in Canada was still a task for the future, and Taverner was the one on whom the task mainly depended. With help from a few experienced ornithologists in Canada, and more in the United States, some of the work of distinguishing among the various species and subspecies of gulls, in their different plumages, was accomplished. But in 1916 there was a great deal still to be discovered. It was like trying to solve a complicated puzzle. Writing to Fleming at this time he said that he had been going through the Red-winged Blackbirds which he called "a badly split up mess", and continued,

"We have nearly 60 specimens but the only subspecies that I can see is *arctolegus* of Oberholser that is not accepted by the A.O.U."[36]

In November 1916 Taverner attended the AOU meeting in Philadelphia, afterwards visiting the National Museum in Washington and the American Museum in New York to examine some of their series. After going over the gulls that he brought with him from Ottawa with Dwight at the American Museum, he left them there for Dwight's further examination. In a letter to Fleming he said that he had come to no definite conclusions but felt that he ought to publish something on the gull question in order to call attention to the question of intergrading, and whether *thayeri* was a true subspecies.[37] Sometimes, in his letters, Taverner gave a close friend his opinion of fellow ornithologists. When Joseph Grinnell, of the University of California at Berkeley, had spent a day at the museum, Taverner told Fleming:

"He appealed to me very strongly. I liked him immensely. Though he is a splitter we agree on so many points in general that we got along nicely. He named the Song Sparrows and the Fox Sparrows for me. He ran foul of Oberholser's determinations on a number of cases [of Song Sparrow subspecies] discarded *rufina* altogether and lumped them under *morphna* . . . and threw out all our Sask. and Alta. birds into *juddi*. H. C. O. [Oberholser] had them all *melodia* but they certainly are

> different from eastern birds. His wife is interested in bats and went over what we have and named them so you see I got something out of the visit . . . Grinnell was much interested in my collection of pictures especially those of fleshy parts of birds. I am certainly getting some good stuff in that line."[38]

The "fleshy parts" refer to the bare parts which are quick to fade once the bird is dead, parts such as eyes, beak, feet, wattles, inflatable sacs and other soft parts.

Although Taverner stayed at the museum during 1916 he arranged for Patch to spend December 1915 and January 1916 collecting in Barkley Sound, Vancouver Island. The principal object of the trip was to collect sea lions, but at the same time he made a good collection of sea birds for the museum, including Barrow's and American goldeneyes, Surf and White-winged scoters (good series in all plumages) and Surf-birds. These were quite a surprise as this species had not been reported previously wintering as far north. He told Fleming that a consignment of birds had just arrived from Patch and that he had Johnson making sketches of the feet and bills.[39] In the summer of 1916 Young joined James Macoun and Spreadborough in eastern British Columbia to collect birds in the Howe Sound and Lillooet area. These two collecting expeditions helped to enlarge the holdings of birds from British Columbia.

The major collection to reach Ottawa during the year was that brought by the Canadian Arctic expedition, though it was some time before it was fully prepared and catalogued. The good news for Taverner was that Anderson was to join the museum staff. In writing to Fleming he mentioned the mammal collection and said, "The Arctic Expedition has returned and I am expecting Dr. Anderson daily. You know he is to be our mammologist and it will be a relief to hand this stuff over to him."[40] Fleming was excited by the opportunity this collection presented for study purposes. Writing to Taverner about a possible monograph on the birds of Labrador that W. E. Clyde Todd might some day write he remarked, a propos of Anderson's expected report on the work of the Southern party: "It ought to be a great opportunity to get out a monograph on Arctic birds. Who will write it? Anderson I suppose."[41] In fact Taverner was chosen to write the section on birds in Volume Two of the official reports of the expedition while Anderson was to contribute the section on mammals. Eventually the volume on geography and geology was published in 1924, and the anthropological reports in 1925. But owing to a long drawn out dispute between members of the Southern party and Stefansson, the leader of the Canadian Arctic Expedition, the volume on natural history was never written.[42] Perhaps this was just as well because owing to the vastness of the area, and the lack of knowledge of the distribution of birds of arctic Canada, the writing of such a monograph would have been premature. The exploration of the breeding grounds and the ranges of many Canadian species remained to be carried out in the 1920s and 1930s [see Chapter 14]. If Taverner had been required to cooperate with Anderson in writing a section on the birds collected by the expedition, quarrelling between the two men might well have begun at the very outset of their years together in the Zoology Section at the museum. There was plenty of time for that later.

Because monographs on Canadian birds, either by categories (sea birds, waders, game birds) or by regions, were comparatively few it was all the more important to have a bibliography of what had been published including articles, local annotated lists and reports. During 1915 Winifred Bentley, general assistant in the Biological Division since 1913, started work on a bibliography of the literature of the ornithology of eastern Canada and Gulf of St. Lawrence, as the beginning of a bibliography of Canadian ornithology.[43]

One way of measuring the value of a museum to the community it serves is by how much the public uses it. Another way is by the educational role it plays in the community. The National Museum took its first step in an educational role during the winter of 1914-1915 when it instituted a number of popular lectures given by members of the museum staff and the Geological Survey. Illustrated lectures on topics relating to the subjects within the scope of the museum's work such as glaciers, fossils, winter birds, Indians of Canada, were offered to audiences from the Normal School, the Collegiate Institute, and the Public Schools of Ottawa in an improvised lecture room at the museum. Taverner's friend, the archaeologist Harlan Smith, was largely responsible for organizing the lectures and gave several himself. Patch and Bentley each gave some but Taverner, because of his speech impediment, was unable to take part. Instead he was responsible for the preparation of the slides required for zoology topics. In the winter of 1915-1916 the scope of the lectures was enlarged and they were continued. A useful addition to the museum's educational function was the loaning of study collections to the Ottawa public schools. Specimen boxes were issued to selected schools containing sets of birds such as common woodpeckers; winter birds (consisting of 13 species that might be seen on a winter's day about the city together with specimens of common winter food); examples of protective coloration of birds and mammals. A total of eleven different boxes were circulated among these schools. The zoological lantern-slide collection was also in demand by scientific and educational bodies in various parts of the Dominion on topics such as "sea birds of Bonaventure Island", while the moving picture on the same subject and the film

showing Jack Miner's success in banding wild geese were shown to scientific and popular gatherings and were received with enthusiasm.[44]

Life at 45 Leonard Avenue continued pleasantly when the family moved back into their home after the fire damage was repaired. Their main preoccupation at this time was the garden which had been in the making since April 1913 when Percy rented a team of horses and a scraper to level the ground. In the spring of 1915 he told Swales that he was working hard on the garden before leaving for the field and added: "though what I want a garden for when I am away all summer is beyond me. Neither do I know what Mother would do without one but the work is too hard for her . . . Last year Mother entered the garden in the city competition and got second prize — with $25."[45] In the autumn Taverner began making a tennis court on the other lot which they owned but had not yet developed. Also at this time he borrowed a book from Fleming on rock gardens with the comment that this was his ideal form of gardening if only he had time to make one.[46] In the spring of 1916 he took a few days' holiday and "worked like a trooper" making a large lily tank in the middle of the lawn. He planted several fragrant water lilies (*Nymphaea*) and an Egyptian lotus. He did most of the work himself, digging out the soil and wheeling it by barrow onto the other lot. At the same time he continued the existing trellis work the whole length of the yard. The garden, and birds that visited it, gave the Taverner family a great deal of enjoyment. One of the first things Percy did when the garden was being laid out in the spring of 1913 was to put up a Purple Martin house. In 1915 a pair nested in it, and in April 1916 three pairs returned to the house. The garden survived the winter well because there was a heavy fall of snow in the autumn of 1915 which lasted until the spring break-up. Percy was able to boast,

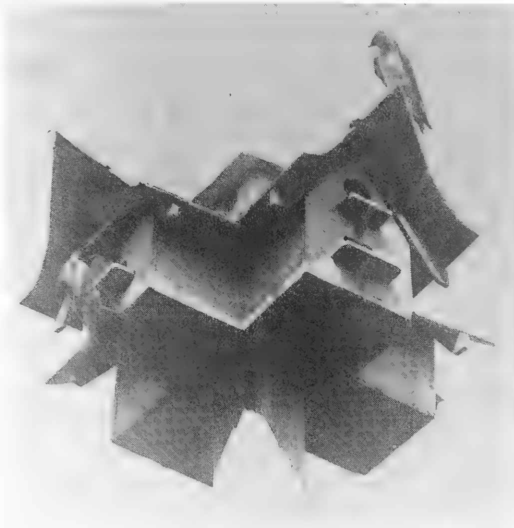
> "In consequence I had California poppies overwinter and are coming on again from the old last years plants. How is that for Ottawa. The Xmas rose was a wonder and when the snow left was covered with great blossoms."[47]

Meanwhile the Purple Martins were a constant joy. He told Fleming,

> "They chatter all day every day and the house is surrounded by a constant flock of them."[48]

Also they were interesting to watch. In June Taverner observed them carrying poplar leaves into their house. He described their actions to Fleming who told him to see if the martins were carrying leaves to their house on hot days. This might be the answer — to cool down the inside of the house.[49] Next spring he put up another house. He told Fleming:

> "Have a new Martin house to put up. It is quite an elaborate affair and is an attempt to put some real design into such a structure. Artistically I think it is a success. We will see what the Martins think about it. Design while not especially attractive to them should not be any deterrent as long as other practical conditions are complied with."[50]



Purple Martins at martin house designed by Taverner. Photographed by Taverner in the garden of his home in Ottawa in the summer of 1916. (Reproduced courtesy of the Canadian Museum of Nature, number 41306.)

In his daily life Percy was constantly using his hands to good advantage. He gave the impression of being self-reliant and a first rate handyman. There are various examples of his readiness to tackle a repair job, or to take on major construction work even if he had no previous experience of that particular job. Gardening and handiwork around the home seem to have been his physical exercise together with field trips to collect and study birds in the summer. In the winter he mentioned skating. Presumably the tennis court was mainly used by Ida and her friends. Percy was not a games-playing man by choice.

Although Ida had a position in the museum library and by this time had made a circle of friends, nevertheless her life was made miserable from time to time by acute outbreaks of eczema. Percy explained the problem in a letter to Fleming.

> "My sister is quite sick so just at present we cannot entertain . . . Ida is not dangerously ill but has such an acute attack of eczema and has to use such villainous looking ointments that she naturally withdraws from the public gaze."[51]

Fleming was sorry to hear this and jokingly suggested she might try "dew on the grass in the early morning", though he added that this was an old English folklore idea. However, to English folklore Fleming added a medical one of his own: "But as a matter of fact constipation is responsible for most

things of the sort."[52] In 1917 Ida went to New York for advice and was told that her eczema might be caused by the state of her teeth. But dental treatment failed to make any permanent cure.[53] In contrast to Ida's health, Percy was fit and well during these years and full of energy both physical and mental. He was clearly enjoying his career, and his home life.

The only dark cloud was caused by the war. All hope that it would be over quickly had long evaporated. If Percy ever had any ambitions to serve his country in the armed forces, as his friend Allan Brooks was doing, his heart murmur would have precluded him on medical grounds. This did not prevent him from expressing his feelings strongly to close friends. During the blackest period of the war he wrote to Louis Bishop about his disgust with American politics as they appeared to an "ex-patriot", referring to his residence in the United States.

> "It is all very well to stick to one's country but only when it deserves it. My accident of Canadian birth that fretted me for many years now is a more comforting thought. We will see in November."[54]

But the United States delayed declaring war until 6 April 1917. Taverner fired a salvo of his own at the U.S. government in a letter to Bishop. The nation, he claimed, had grown too soft with mollycoddleism, prohibitionism, feminism, and Audubonism culminating finally in pacifism and "I did not raise my boy to be a soldier" mentality.

> "All are emanations of the same fundamental spirit of wrapping the unfit in cotton-wool . . . It is because I am more or less still American that [I] hate to see the nation stultifying itself."[55]

The influence of Darwin's *Origin of Species*, which he had read with strong feelings of empathy as a young man, now came to haunt him over the human condition in wartime. Part of his letter to Bishop was about war being more or less a biological necessity for the human species. This was a dangerous argument which he was to express again during the Second World War. However, writing to Fleming in February 1917 he was rather more perceptive. He commented that it looked as if the United States would enter the war "with us". Taverner was glad because he considered that it would be a distinct loss to the world if the war finished without the U. S. being directly touched by it.

> "The demonstration that even the extreme of diplomacy will not avoid trouble will make them more willing to assist in preventing the rise of aggressors in the future."[56]

In contrast to Taverner's attitude towards the war his new colleague in the department of zoology at the museum, Rudolph Anderson, was more bellicose, at least on paper. Taverner had written to Fleming to tell him that Anderson would be in Toronto at the end of March 1917 when he was due to address the Royal Canadian Institute on the Canadian Arctic Expedition, and that Mrs. Anderson would be with him as she was also to give a lecture. They were due to go to Hamilton on the following Monday. Diplomatically Taverner suggested

> "It would be well, if not in opposition to your other plans, if you could have them out to your house sometime Sunday".[57]

This was the first meeting between Fleming and Anderson, and it began a correspondence between them during which Anderson expressed his feelings about the war. In a letter to Fleming in June 1917 he mentioned that Taverner was in Red Deer, Alberta, preparing to raft down the river to join the Sternbergs who were digging for dinosaurs in the badlands near Drumheller. Anderson commented

> "I find it pretty hard work to stick to museum work with all the war excitement this summer, both in Canada and the U.S. My personal preferences are all for flying the coop and getting into the big game".[58]

Fleming in his reply suggested, either through ignorance or with his tongue in his cheek, that since Anderson had a degree in medicine his services would be very valuable in the army. Anderson replied that he only had a Ph.D. in the, at present, unpractical sciences of zoology and animal morphology.

> "If I were a medical man, I could see my duty more clearly, as physicians and surgeons are badly needed everywhere.
>
> "I could get a commission as captain, or possibly major, of infantry without much trouble by going back to the U.S., into the new National Army, but it doesn't look well to be a "hyphenate," so I suppose I'd better repress my military desires until Canada invites me to take up the job of little buck private. The infantry is the only branch that appeals to me, as there is something personal about the rifle and bayonet that is lacking when one deals with events by machinery several miles away."[59]

The physical difference between the two men was very pronounced. Taverner was tall, lean and bearded while Anderson was tall, thick set and clean shaven. Anderson had recently returned from three consecutive years of field work in the Arctic while Taverner had completed five years of museum work in Ottawa. Anderson's background was university, army, football, and athletics; Taverner's background was non-academic, non-military, and cultural rather than sporting. Anderson had already published a book on birds, Taverner was in the process of writing one. In age Taverner was one year Anderson's senior. These two men were to be close associates at the National Museum for the next quarter of a century.[60]

Now that Anderson had taken charge of the mammals Taverner was able to concentrate entirely on the bird collections. Moreover, since Parliament continued to occupy much of the museum building, staff did not have to spend time on making their collections open to visitors. As a result Taverner was able to devote much of his time to the study and classification of the enlarged collections of bird skins. The problems caused by the determination of these speci-

mens occupied an increasing place in his correspondence with ornithological friends and acquaintances.

For instance Taverner was working through the specimens of Savannah Sparrows and found a form taken on Vancouver Island which did not appear to have been described before. He told Fleming:

> "Either Ridgway is color blind or else there is a whopping new subspecies in western Canada. I see Swarth calls the Vancouver Island bird Savannah but this it certainly is not."

He then described it.[61] Between early February and early May 1917 ten letters between Taverner and Fleming discussed this hypothetical new subspecies without reaching any definite conclusion. Taverner, with his sardonic sense of humour, compared what they were doing to a game.

> "It is a great game; look wise, name everything, never retract and bluff it out and one can easily make a great name as an ornithologist. The trouble is that the splitting is too fine and when we get through we have shavings and chips and not building lumber."[62]

When Fleming copied out Lucien Bonaparte's description of *Passerculus anthinus* Taverner withdrew his tentative description of a new subspecies of Savannah Sparrow because he came to the conclusion that his bird was only an *anthinus*.[63] But such an exercise in determining correct names for specimens in the museum collection was of value to Taverner. The more determinations he made now the more certain he was likely to be over which forms might be considered "good", and therefore described in literature in the future. Other hypothetic forms that Taverner and Fleming were discussing at this period were subspecies of Song Sparrow, Fox Sparrow, and Merlin.

But the most important development in Taverner's career was that at last he was free to turn his attention to the study of the bird life of the western provinces of Canada in the field. There is evidence that he was very conscious of his lack of first hand experience of the birds of the prairies and British Columbia. In a letter to Brooks in 1916 he explained that after he had managed to do some work in the prairie provinces he would then turn to the localities in British Columbia which Brooks had spoken of and added: "Perhaps I may have the pleasure of your company there".[64] In May 1917 he was able to leave Ottawa for Manitoba where he collected in the vicinity of Shoal Lake. Later he moved to the Red Deer river in Alberta, and then to Jasper National Park. While in the field large collections were made so that the birds of the west might be more fully represented in the National Museum's collections.

Meanwhile Taverner was running into difficulties over the content of his book on the birds of eastern Canada. He had intended to write a book that would be of practical use for the identification of Canadian birds but would also stimulate the reader's interest through the appeal of birds to his aesthetic sense. But the "powers that be" thought differently, as Taverner told Fleming.

> "The bird book is causing me a lot of trouble. McInnes is the Acting Director of the Survey now and it is in his hands and he has not done a thing to it. He seems to think that nothing but the baldest kind of statements are allowable and would turn it into a census tabulation. Your citicisms are very mild indeed in comparison. Unless I can influence him it will be only a Reed's Bird Guide, or less. It is not the expense he objects to and I fail to catch his standpoint at all except that he is a scientific purist, and thinks that nothing that is popular [is] within the dignity of the Geological Survey. I am going up to have it out with him tomorrow. Such is the way, I really miss Brock now. He at least was not fossilized."[65]

While Percy was enjoying his first acquaintance with the landscape and the birds of the prairie provinces his mother and sister were enjoying a visit to a lakeside cottage. In July 1917 they were invited by a friend to stay at Blue Sea Lake in Quebec province, and they fell in love with the place. The following month they returned with friends to stay at a cottage on Big Island which was loaned to them for a few weeks while the owners were away. Before they returned to Ottawa Mrs. Taverner had arranged to buy lot number 4 on the island. There were good reasons for their hasty "love at first sight" reaction. Nostalgia for the years of cottage and lakeside living at Beaumaris lay deep in their memories. However pleasant life was becoming in Ottawa, when the warmth of summer returned and their friends left for "the cottage", they longed for a cottage of their own. The journey from Ottawa to the village of Messines, at Blue Sea Lake, took three hours or more by a single-track railway running beside the dark waters of the Gatineau River into rural Quebec. The railway ran through cuttings of pale grey granite blotched with pinkish-brown outcrops, with the river winding below, until Blue Sea Lake was reached and the train ran its scenic course beside the lake. Big Island rose steeply out of the water and was completely covered with trees. The view from lot number 4 faced south down the lake with a wooded island to left and right in the middle distance framing the view and directing one's eyes through a channel between the islands to a wooded shoreline in the further distance. On a sunny day, with only a slight breeze, the blue surface of the lake reflected the light and mirrored the large white clouds that sailed slowly above it. One had the feeling of being raised above the surface of the lake, near to the wide expanse of sky, yet contained by the horizons of low forest-covered hills. It was a view to enlarge the human spirit. When Percy returned from his expedition to the western provinces he was presented with the challenge of building a cottage on the island lot which the Taverner family now owned. For some undisclosed reason Percy visited Lake Muskoka at the end of September. It was only eleven years since the Taverners had sold their cottage at Beaumaris and they still had friends there.[66] Finally

at Thanksgiving 1917 Percy first saw the location selected for their family cottage.

In spite of the grim events of the war, and the collapse of Imperial Russia on the eastern front, 1917 had been a good year for Percy Taverner.

At the beginning of 1918 the Biological Division finally had to move out of the museum to make room for forty new members of Parliament. Since the specimens were already packed this was not too troublesome, and the whole Division was able to remain together on the top floor of a large building nearby which was fireproof, an improvement on the museum building. It also had good light since the west side was made of glass. The only drawback was the lack of an elevator; the staff had to climb four flights of stairs to get to their offices. The preparation shops remained where they were. Because the library remained in the museum while other Divisions were scattered in various parts of Ottawa, it was time consuming for Taverner when he needed to consult other museum members, or use the library.[67]

Two welcome events in 1918 should, in Taverner's mind, have more than compensated for being uprooted. Taverner finished the manuscript of his book and sent it to the editor and, although it was not quite what he wanted, he told Fleming that he was fairly satisfied with it. Also at this time he became a Fellow of the AOU which carried much status with it. He also felt that Gordon Hewitt was now consulting him more on matters of bird protection while setting up federal regulations to enforce the International Migratory Bird Treaty. But of greater significance to Taverner, personally, at this time was the question of who was to be head of the Biological Division. James Macoun had been appointed Acting Head in 1917 which pleased Taverner well, as he confided to Fleming. "I am glad this appointment has been made. He is the right man in the place, having good executive [word illegible] and a wider outlook than any other man on the staff. I get along with him very well indeed and he is a man of influence. He has the promise of a real staff under him at an early date. The return of the Arctic Expedition has brought things to a head."[68] Anderson now began to make a number of requests and suggestions to Jim Macoun regarding the work and personnel of the Biological Division which Macoun in turn passed on to the Deputy Minister R. G. McConnell. In one covering letter Macoun wrote: "While the duties of Acting Head of the Biological Division are not at present onerous, they are troublesome, and matters come up which cannot be dealt with satisfactorily except by the one [who] is the real responsible head of the division."[69] As though in response McConnell made Macoun Head of Division immediately. But Jim found that his increased authority did not necessarily make it any easier to mediate in internal differences. His position as Curator of the National Herbarium give him more satisfaction, and his field work more pleasure than being Head of the Biological Division.[70] The summers of 1917, 1918, and 1919 he spent with Spreadborough as assistant, making a botanical survey of the Jasper Park region. At the end of each field season Jim returned to Vancouver for a short visit with his father before returning to Ottawa.[71]

Meanwhile the museum staff faced a reclassification of the Civil Service involving status and salary. Writing to Fleming in the fall of 1918 Taverner explained,

> "We all have cards to fill and are searching the dictionary for words in which to express the importance of our work. I have found a number of them but as yet not found how to work them in."[72]

Eventually, when the new scheme was made known in July 1919, it came as a shock. It seems that some people, when filling in the form, laid most stress on the administrative work they were performing as though this carried more clout than anything else. But in doing so they failed to double guess the attitude of the revising board correctly. Taverner's explanation was that members of the board, when setting the new salaries, regarded the work of administration as considerably lower in value than research work. In fact no upper limit was placed on the salary of those whose replies showed them to be mainly "research men", while being engaged mainly in administration was rated as detrimental rather than advantageous. As a result Taverner's salary advanced immediately to $3300.00 and was not pegged to any upper limit while Jim Macoun and Anderson both found their salaries lowered and pegged to a limit. But, as Taverner told Fleming, of course it was going to be revised.[73] Writing to Macoun on the subject Taverner gave his own opinion.

> "Of course the distinction made between Dr. A and myself is absurd. The ignoring of you as botanist is also a bull . . . Under it you, as Head of Division, would not have as good prospects as you should as Botanist . . . Of course I am satisfied with my status [and] am not anxious to have it reduced but would like to see Anderson brought up at least equal as he should be."[74]

During the years 1918 and 1919 Taverner was busy with a variety of aspects of museum work, both advising on policy and building up the collections. He was required to write a memorandum for the minister, McConnell, on the need for the museum to have extralimital bird specimens in its collection for research purposes.[75] During 1918 a total of 1300 new specimens were added to the collection, and work continued on preparing groups for exhibition. Taverner's own collecting was limited to Ontario during 1918 and 1919. Work on the study and classification of the collection went on unabated. Early in 1918 he worked through the juncos and kinglets; later the hummingbirds when he arranged an exchange of some with Fleming.[76] Writing to Brooks

in the fall, Taverner could be pleased with the progress being made. Young had continued the previous year's work at Shoal Lake, Manitoba and had collected over 600 birds, while Spreadborough brought back some good specimens from Jasper Park, Alberta. In an optimistic vein he continued:

"The museum has really gone ahead most satisfactorily though at times the indifference of our chief is maddening. Fortunately Macoun is now in charge of the Biological Division and if the promised reorganization goes through we have good hopes of the future."[77]

His opinion of the Director of the Museum, McInnes, however, was expressed bluntly in a letter to Fleming when he wrote

"Wish we had a director that had enough gumption to try and make the department useful, — at any rate a bluff at it. We surely have a King Log now. The Survey is in a very bad way. All the energy and ambition has been taken out of the staff."[78]

By 1918 Taverner was in touch with a number of enthusiastic amateur ornithologists several of whom were younger men seeking a career related to the study of birds, and an outdoor life. He was fortunate to know people such as Fleming and Saunders, Harkin and Hewitt who told him of people he might find helpful as correspondents. For instance Gordon Hewitt showed him a recently published annotated list of the birds of the Wolfville region of Nova Scotia. Local faunal lists were valuable to Taverner in his task of mapping the distribution of Canadian birds.[79] He wrote to the author, Robie W. Tufts, asking for a copy and explaining his interest.

"I am endeavoring to keep in touch with and to correlate all ornithological endeavor in the Dominion and your assistance in this direction will be greatly appreciated."[80]

From his office in the National Museum Taverner sat at the centre of an expanding network of correspondents who kept him informed of what was happening, ornithologically, in their own areas. He could expect to receive both information and specimens to add to the collections. There was so much that the museum required such as specimens of nests and eggs, and nesting records of various species from a number of provinces. As an example Taverner mentioned White-winged Scoters off the coast of Labrador. He had seen thousands of them in the summer of 1915 in all plumages, both male and female, yet he knew of no nesting records.[81]

Another new correspondent was Fred Bradshaw, Chief Game Guardian for Saskatchewan. Taverner was in touch with him in 1919 about the possibility of coming to his province on a field trip the following year and wrote:

"Would like to get enough data to prepare a local Sask. list like those of the Red Deer and Shoal Lake. Mr. Fleming is publishing one for the northern part of the Province. These local lists to my mind are very important for we are really unable to put out a complete provincial list until we have enough of the more local ones to form a basis. Saskatchewan is now the western Province most poorly provided with such results but we hope to remedy this in the near future."[82]

Bradshaw replied that a start had been made on a bird list and enclosed a copy of the Game Guardian's annual report for Saskatchewan.[83] In his reply Taverner suggested that in the next report it would be helpful if Bradshaw could annotate the list to indicate which birds were common and widely distributed and which were stragglers, or confined to limited areas. Also he encouraged Bradshaw to obtain records on the fluctuations of grouse over a long series of years, and recommended that game wardens under him be required to make systematic reports on grouse including abundance or otherwise of food, and of the predators, bird and mammal, that fed on grouse.[84]

A new contact in Quebec province was W. J. Brown of Montreal. Brown had written to Taverner early in 1919 to congratulate him on his report on the birds of Red Deer River.[85] In thanking him Taverner revealed his ideas on the importance of interesting the general public in birds. To do this the museum would need to conduct a campaign of education in order to rouse the public to prod the government into action.

"As it is I fear the government reflects the public but too well. I was in hopes that we were going to establish a truly National Museum when I came here but after building a fine expensive building it laid down on the job and refused to equip it with either facilities or personnel. I think however there are signs of awakening and if the few of us there make enough noise we can give the effect of a crowd. So all get behind and push."[86]

Brown responded warmly to Taverner's letter and wrote:

"After grasping the fact that there was at least one other who thoroughly recognized our shortcomings, I felt relieved, and frankly it makes cheerful reading to know that the right man is at the helm. For years I could never understand why Canadians were so inactive and disinterested while our neighbours to the south were progressing rapidly in this most fascinating study."[87]

With a few correspondents showing the same appreciation of what he was trying to achieve Taverner must have felt encouraged to retain his belief in the value of his ornithological work in spite of the apparent inertia of his superiors. Brown sent him some notes on various species seen in Montreal, and a promise to help in collecting specimens. This prompted Taverner to write to Brown about another of his main concerns:

"Good working collections are the tools that are most lacking in Canada today. American results when published are as available to Canadian workers as to American ones and from a broad scientific standard as good. Collections however in the States are not available to us and hence until we get good series of necessary species we are still dependent upon others for any sound work. I feel it my first duty to build up these collections as working tools. I have tried to conduct an educational

campaign incidentally but it has been up hill work overcoming inertia. I am very hopeful now that we have Mr. Lloyd taking up an agressive policy in this direction. I think he is well prepared for it and has the full backing of his department. One great advantage he has is that he belongs to a new department that is not tied up with a couple of generations or more of tradition and precedent.

We are trying to get some interest stirred up in making the Ottawa Naturalist a medium of intercommunication between all the Natural History Societies in the Dominion. A letter with a scheme for closer cooperation will reach the Sec. of your Bird Protection Club shortly and I hope that it will meet with general approval."[88]

When Brown asked what birds were needed Taverner replied that he would be glad to have additions to any series. He told Brown that the museum contained almost nothing from the Montreal region and would be glad to receive anything, bird or mammal, that could be procured. Whilst rarity was welcome in a specimen, a complete collection from his important region was the ideal; nothing was too common at this stage for usefulness. Hawks and owls, being the hardest to obtain, were very desirable. Great Horned Owls were especially welcome because Taverner was hoping, some day, to work out the geographical races into which this species had been split. But to do this he needed large series, and this would take time to obtain. "Birds actually known to be breeding are the crux of the question and whilst migrants are desirable breeding birds are the final necessity."[89] Taverner also mentioned that the museum was anxious to obtain nests and eggs as well, especially nests *in situ* for use in life history groups, and invited Brown to come to the museum to see the work they were doing in that direction.[90] Taverner showed a natural ability to say the right thing when writing to people predisposed to help the ornithology section at the museum. His correspondence with Brown, Mousley, and others shows him taking trouble to encourage, help and advise them with the result that they in turn became enthusiastic to help the museum.[91] This did not apply to his letters only but also to his meetings with those of like-minded interests — in spite of his stammer.

The Commission of Conservation also claimed a share of Taverner's time during the war years. One major advance which was to be of great help to Taverner during his future career was the appointment of Hoyes Lloyd as ornithologist with the Dominion Parks Branch when this position was established in 1918. Lloyd was one of several applicants when the Civil Service Commission advertised for someone to assist the Parks Branch in the administration of the Migratory Bird Act. Fleming knew Lloyd as a keen student of birds living in Toronto, and favoured his appointment to the post. He also realized the importance to Taverner of appointing the right man for the job. He told Taverner:

"I feel he is the right man to cooperate with you, and would be of immense value to Harkin. Lloyd will shine in investigating economic problems such as will arise in ornithology."[92]

Apparently Klugh and Munro both wanted the job but Fleming was not in favour of their appointment because he considered them too combative and lacking the tact needed for such a difficult job. Instead he again expounded on Lloyd's good qualities and the fact that he was a "thorough student of birds".[93] Taverner, therefore, was favorably disposed towards Hoyes Lloyd when he came to Ottawa to be interviewed by Harkin, Hewitt, and Anderson. Lloyd called on Taverner who introduced him to Anderson who in turn introduced him to the other two members of the interviewing committee. When Lloyd was the successful applicant Fleming wrote to Taverner:

"I saw Lloyd last night, he appears much pleased with the way everyone treated him and you have added another admirer to your long list."[94]

This is an allusion to Taverner's ability to warm people towards him by his friendly manner. In reply to a further letter from Fleming praising Lloyd's analytical mind Taverner said he, also, thought that Loyd was the right man for the job, and that he would try to make him feel at home in Ottawa. The Taverner family invited Lloyd to their house on Christmas Day.[95] So began a close friendship between Taverner and Lloyd which was to last, to the benefit of both men, until Taverner's death.

Two pleasant things occurred early in 1919 that affected Taverner. He received a letter informing him that his name would be proposed as a Colonial Member of the British Ornithologists' Union. Thinking that Fleming had sent his name forward he wrote asking him how much it cost to become a member before committing himself and said: "I appreciate the honor and am glad to get it. Probably it is your suggestion."[96] Fleming replied that he had nothing to do with the proposal but was very glad to hear of it; that it was certainly an honor, that membership in that category was limited to ten; that it involved no subscription and no obligations; and the only privilege was to be able to subscribe to *Ibis* on equal terms with members (£25 per annum).[97] As a result Taverner was now a Fellow of the American Ornithologists' Union, a Colonial Member of the British Ornithologists' Union, and had a book on the birds of eastern Canada in the press. He had reason to be pleased with the achievements he had to show for all his hard work since his arrival at the museum in 1911.

Taverner first met Fred Bradshaw, Chief Game Guardian, Province of Saskatchewan while attending a national conference on wildlife protection held at Ottawa in February 1919. When Bradshaw told Taverner that a new museum was being planned for Regina Taverner suggested to him that H. H. Mitchell, provincial naturalist and taxidermist at the existing museum, should come to the National Museum to work with Clyde Patch and observe his methods. This was part of Taverner's perception of

his role as ornithologist at the National Museum — to help provincial museums to train their staff in up to date methods. Apart from this it would be pleasant to renew acquaintance with Mitchell whom he had known from long ago when Mitchell was working at Spanner's taxidermist shop in Toronto. It would also give Taverner another useful contact to include in the growing list of those he was in touch with across the Dominion.[98]

Brooks was now back into collecting specimens for his own museum, and when he had surplus ones not yet in the National Museum collection he presented one of each to it. In this way Brooks added four "Canadian" species in 1919, namely: Canyon Wren, Sage Thrasher, Brewer's Sparrow and White-throated Swift collected by Charles de B. Green and George Gartell.[99] Taverner's own collecting of specimens from the western prairies would not begin on a large scale until the 1920s.

In spite of not being a married man, Percy's family life continued contentedly enough. When Ida was seeking a cure for her eczema in New York for five months in 1918, accompanied by her mother, he had to fend for himself. Being an extremely practical man and able to cook in a rough fashion he survived perfectly well but, as he confessed to Fleming, he had learned that "batching is not a comfortable life". The Taverners had a pleasant home, which Percy had designed, in a very attractive part of Ottawa with a garden which Percy worked hard to create and maintain. As a family they entertained regularly so that Percy was able to invite his friends and acquaintances to a meal, or offer them accommodation when they were in Ottawa. But because Ida was working in the museum library each day, and Percy was fully employed in his professional work, the running of the home fell on Mrs. Taverner who was now in her sixty-fourth year. Perhaps his extended experience as a "bachelor" alerted Percy to the burden that his mother was carrying. Percy hoped to find someone who would come to live with them while sharing the running of the home with his mother.[100] The three Taverners were a loving and close knit family, and Percy was lucky to have such a good home life to support him in fulfilling the demands which he made on himself in his efforts to stimulate the study and enjoyment of ornithology across Canada.

Looking back at the end of 1919 on the eight and a half years that Percy had served at the museum we have gained some perception of his relations with his friends and colleagues, and we know something of his affection towards his mother and sister. We know that he had an appreciation of music, and painting, and gardening, and that he had an artistic eye. We have seen the principles on which his character had developed, and how his outlook on major social problems had matured during recent years. Two examples may help to show how he felt on deep human questions. One was the issue of prohibition. Both Fleming and Taverner were convivial, and enjoyed having a drink together. When he received a comic account from Fleming of spending a few days at Point Pelee with Saunders, Wallace, and Jack Miner, all strong teetotallers who tried to persuade him not to have a drink, Percy gave a serious reply which showed his feelings on the wider implications of the subject. Fleming had argued against prohibition on the grounds that it was an unwarranted infringement of people's liberties and any confiscation of property without compensation was scandalous. Although Percy liked his glass of beer, nevertheless he felt that the country was much better under prohibition, and was willing, he wrote, to forgo his personal inclinations for it. He never found any use for liquor as a medicine except when given under strictly medicinal conditions. Then he shifted the argument to a very topical issue.

> "If Winnipeg had been wet during the late strike there I think conditions would have been immensely more serious. If all the soldiers could have boozed away their gratuities things would be bad indeed. I know they can get it but only at a high price and with difficulty . . . and with malice aforethought. On the whole I am for prohibition though I think that mild beer could still be allowed and that investors in the liquor business should have been reimbursed or at least been given sufficient time to readjust their works."[101]

Taverner had something more to say on the subject of strikes when writing to Fleming about the reclassification of the Civil Service in 1919.

> "Speaking of the Civil Service though I wonder if the country realized that it has not had a raise since 1908? What other large employer can run today on a 1908 basis? It seems the only way to get just consideration is through organization and strike? . . . I deprecate strikes but they seem the only cure until employers will meet employees in an honest effort to concede what is just . . . Surely it is putting a premium on striking when only strikers receive consideration. Last year the lower divisions of the service received a bonus, about one fourth of what the price index indicated as a fair increase. Higher divisions received nothing — except the highest, deputy Ministers who got $1000 increase in salary, — not bonus. When the lowest and the highest get raises does it look logical to neglect the intermediate. This year we all get [a] bonus, highest in the lowest divisions and scaled down above. My bonus will be about nine dollars a month. Glad to get this but it is a mere bagatelle in comparing prewar with present conditions. Of course I understand that we all have to stand our share of the burden of the war but why should more be expected of Civil Servants than of railroad and munition employes? The answer is they will stand for it, the others won't."[102]

Taverner had quite strong opinions on social and political questions, and was capable of expressing them forcefully in writing when roused.

By now the Andersons had settled into a house near the Rideau Canal, and the two families began to get to know one another. Taverner, writing to Jim Macoun in August 1919, said that he had taken

Anderson on a visit to Blue Sea Lake to look at alternative sites for building a cottage on his lot. While there they went to the local sawmill to buy timber, and then explored the lake in a borrowed power boat. Taverner reported to Macoun:

> "Anderson and I just returned from a weekend at Blue Sea [Lake]. Had a fine little visit there and I think Anderson is quite enthused over the place. Would not be surprised if he looked for a place there. He certainly opened up in camp and makes a good camp fellow."[103]

The next weekend the Taverner family came up by train and chose a site for the cottage facing south down the lake. Percy had taken a three week vacation and the timber required was delivered to the nearest shore and towed across to the site. By the end of their stay, working with the help of one local man, he nearly managed to finish his summer cottage. The family agreed on the name "Hyla" — tree frog — for their new cottage. Writing to Fleming in mid-September he could say, with a touch of satisfaction, that the cottage was now in fair shape with the windows and doors hung, and the smokestack in place, and that he would finish it on the next weekend "so mother can occupy it next summer when I am away." The plan, which he drew up himself, was, he said, "rather unique" since it had folding doors with glass the whole length which could be thrown open to give access to the porch. In good weather the porch and living room could be made practically one room.[104] Near the end of September the Taverners' first guests, the Andersons, arrived. The visit is recorded in the Hyla log book.

> "On the last day of our stay, all buckled in and put the finishing touches to the cottage. Mrs. Anderson stained the doors, and said she would think all winter about the two doors for which there was not enough stain. The partitions were all up, shelves etc. in the kitchen, the windlass for hauling up the water, stand for water barrel made, and when we left the place on Sept. 29, it was practically complete."[105]

Anderson wrote to Fleming in October about a visit he had made to Point Pelee to interview parties in a dispute over the trapping of muskrats and mentioned that Taverner had built an artistic cottage on Big Island.[106] In mid-October the Andersons themselves bought a lot on Big Island.[107]

At this point in his life Percy Taverner might congratulate himself on his pleasant prospects for the future with an increase in salary, and a summer cottage all ready for occupation next summer. But no sooner had he settled down to face the long winter than he had to face the worst possible news. Jim Macoun had become progressively ill and in November exploratory surgery showed that he had an advanced cancer. He died in January 1920 at the age of fifty-seven.[108] Taverner had expected that his pleasant relations with Jim Macoun, both as a friend and as head of the Biological Division, would continue for many years. Now he suddenly was faced with the question of who would be appointed head of the Biological Division. The choice was between Anderson and himself, but since Anderson had a doctorate in zoology and Taverner had no higher education the odds were weighted in Anderson's favour. In March 1920 Dr. Rudolf Martin Anderson was appointed acting head of the Biological Division.

In the two preceding chapters a fairly detailed account of Taverner's early career at the National Museum of Canada has been given with emphasis on his work in the museum rather than in the field. It is hoped that the reader now has an idea of the working of the ornithological section. The next three chapters will focus on Taverner's work by topical themes. Chapter 8 concentrates on the part played by Taverner in building up the bird collections and the field trips he went on himself, or organized for others to participate in. Chapter 9 outlines the role played by Taverner in protecting wild birds in the vital years of wildlife conservation in Canada between 1911 and 1919. Taverner was responsible for giving firsthand evidence, in his position as the National Museum ornithologist, on the situation at Point Pelee and at Bonaventure and the Bird Islands in the Gulf of St. Lawrence. Chapter 10 outlines the work that went into the writing of his first book which described the birds of Canada as opposed to merely cataloguing them. It is important to understand his objects and methods in writing this book since they set out the style and format which his subsequent bird books would follow. This chapter also will include information on the part Taverner played in enlarging and upgrading the Journal of the Ottawa Field Naturalists' Club from a local journal into one designed to appeal to the interests of naturalists across Canada. (It became the *Canadian Field-Naturalist* in 1919.) These three chapters will bring Percy Taverner's career to the year 1920 and the beginning of two decades of high hopes between the two world wars.

## CHAPTER 8. Field Collecting

*Point Pelee 1913*

The first field expedition that Taverner undertook was in the summer of 1913 when with Clyde Patch and Charles Young he camped at Point Pelee for nine weeks. This was his first experience in the difficulties of mounting and carrying out a museum expedition. The object of the expedition was to collect material for a Canadian Carolinian group showing characteristic birds and mammals in a typical Carolinian landscape.[1] In order to identify the plants and trees that he would need for leaves and branches in making the group he hoped to have the help of his

friend K. C. Dodge, of Port Huron, who had compiled a list of the flora of Point Pelee as a result of visits there in 1910.[2] He also hoped to go over to Pelee Island to verify the accuracy of Lynds Jones' records from the Island.[3]

The first problem that faced Percy was uncertainty of whether the expedition would be able to leave Ottawa at all owing to the slowness of government in passing the yearly financial appropriation for the museum. Until Parliament voted the money at the beginning of the new financial year at the beginning of April everything was in doubt. Taverner wanted to reach Pelee early in May in order to catch the early spring migration but was delayed by Parliament and by problems of getting the various supplies required from the various departments involved.[4] Finally, on May 15, Taverner with Patch and Mrs. Patch (who had been engaged to do the cooking) arrived at Point Pelee in the rain with a cold wind blowing. The collecting of specimens began in earnest when Young arrived two days later. From now until the end of the expedition on 24 July Taverner kept a record in the Great Lakes Ornithological Club's roll book kept in the shack, of birds seen or collected as well as brief notes on the day's activities.[5] Sightings began on a good note when Taverner found a large black looking duck on one of the ponds and thought it was an American Scoter [Black Scoter]. However, it was in an intermediate plumage without a white spot on its crown and the white on the neck obscured. Later he returned and collected it, when it proved to be a Surf Scoter (19 May).[6] On the same day he took a male Prothonotary Warbler. Both were first records for Point Pelee. In the last week of May they found several nests of Piping Plover with eggs while other nests were discovered in June. The first eggs to hatch had four young by 11 June, and Taverner took photographs of them. Another bird sighting of interest was a Cory's Least Bittern which flushed in company with a regular Least Bittern. They were both collected and the Cory's proved to be a non breeding female. The three men pushed themselves hard since there was much collecting to be done before they had all the material they needed. They usually were away from camp soon after first light, and were often preparing specimens by the light of lamps in the evening. But not all was intensive work without relaxation.

Percy had invited three entomologists of the Detroit Natural History Club whom he knew from his Detroit days, A. W. Andrews, W. W. Newcomb and W. S. McAlpine, for the last weekend in May. By chance three members of the GLOC, Fleming, Saunders and Wallace decided to use the club shack at the Point on the same weekend. This made nine men from Friday evening until Monday. It must have been great fun for everyone except Mrs. Patch who did all the cooking. Apart from collecting in congenial company Percy had the rare opportunity to discuss with other members of the GLOC the problem of preserving the beaches of Point Pelee from being carried away by an American company's sand and gravel mining.[7] One active member of the GLOC absent from the get-together was Bradshaw Swales who was recovering from an operation for appendicitis. To remedy this in a small way the visitors joined Taverner in writing the following "get well" letter to Swales:

> "We, the members of the Camp Coues Ornithological Club, having met for the ninth consecutive season, in our club quarters, together with the Detroit Naturalist Club who are visiting us for a few days, join in regretting the absence of their common member and send greetings and express sincere wishes for your speedy recovery to health and reappearance in our midst, June 1st '13.
> A. W. Andrews, W. W. Newcomb, Jas. S. Wallace, W. E. Saunders, J. H. Fleming, P. A. Taverner, W. S. McAlpine."

Bert Gardner, on whose land they were camping, was invited to join in signing the letter.[8]

Early in June Taverner and Young started looking for samples of Carolinian foliage to use in their display groups — such as magnolia, tulip tree and pawpaw. But while looking for plants they kept a sharp eye open for unusual birds. One day, while returning from a trip to Leamington they saw a Dickcissel perched on a post singing. When they returned two days later they found at least six pairs of Dickcissels in the field just north of the dyke at the base of the Point. They were evidently breeding in the fields there. While searching for nests they disturbed two Henslow's Sparrows. In mid June they had more luck. They found a male and female Lark Sparrow near the Point, and a [Northern] Mockingbird sang in the cedars near to the shack one evening. Taverner was particularly elated by this because he had never heard a mockingbird's song before. Just when the work was going really well things began to fall apart. Writing to Jim Macoun on 19 June he said that Dodge was sick and did not expect to be able to come to Pelee until 5 July and then only for a weekend. This was unfortunate since Percy needed help from a botanist for identifications and advice on what should be included in a Carolinian group.[9] The following day he had more bad news. Writing to Fleming he said that Young had to return to Ottawa very recently on a family matter, which left the collecting party short-handed. The absence of Young indefinitely, and the failure of Dodge to come in June were blows that upset his careful plan. He did not feel that he should go to Pelee Island alone, he could not very well take Patch with him, so unless Fleming or Saunders could come with him he would have to call off the visit.[10] As it turned out Fleming could not go and Saunders wired him at the last moment that he also could not go. This was a shame

because Taverner ought to have explored Pelee Island and compared its bird population in the summer with that at the Point. He never had another opportunity to see the territory where Lynds Jones made so many extraordinary sight records without corroborating them with specimens.

Without Young the preparation of material for the Carolinian group took much longer than expected. Brock had instructed Taverner to have an exhibition ready for the members of the International Geological Congress showing the museum's methods and future plans.[11] Taverner had hoped to leave Point Pelee at least by mid July so as to give himself sufficient time to prepare but it was 24 July when he left. Percy gave a last glimpse of the group driving into Leamington to catch the train in one of his letters to Fleming:

> "We had a great rustle getting away at all and when our wagons were at last loaded and filing into Leamington I felt like the manager of a circus on parade."[12]

Apart from the information in Taverner's report on the Pelee expedition (see note 1) it is worth noting that on his first field expedition Percy put one of his special skills, photography, to good use. He took photos of mammals such as four flying squirrels and their young, and reptiles such as the twenty-five blue-tailed [five-lined] skinks which Saunders saw while visiting the camp, and noted as "wonderfully variable in color".[13] Percy also took various views of the scenery at Point Pelee in 1913 which have survived.[14] When the party left the Point the fall migration of shore birds had not yet begun in earnest and Taverner regretted the circumstances which compelled him to leave before the migration had started.[15] But the expedition, in spite of problems, was a success. Taverner found Young to be an excellent field worker, and they got on well together, while Percy proved to be a tireless leader. As regards the bird collecting Saunders summed it up in a letter to Swales when he wrote:

> "The Point has done itself proud this year as it would any year if an enthusiast like Percy went down and stayed there."[16]

*Gulf of St. Lawrence 1914*
(Miscou and Bonaventure Islands)

With the successful completion of a field expedition to the southernmost part of eastern Canada Taverner could now decide where he should go next. Because the museum collection was seriously weak in eastern specimens and comparatively better off in birds from western provinces he decided that systematic collecting should begin in the eastern part of Canada.[17] The decision on where to go was not a difficult one to make; it was made for him.

In March 1914 Taverner heard a rumour of a movement to develop the top of the famous Percé Rock in the Cape Gaspé for sightseeing. Writing to Fleming he mentioned that the rumour included an elevator to the top and a pavilion and merry-go-round.[18] A few days later, in a letter to Allan Brooks, Percy let his imagination run away, adding to the list of improvements to nature such things as summer hotels and shute-the-shutes [chute] as well. But he was serious about the implications for sea birds on the eastern coast of Canada where breeding places were becoming more restricted every year. The Rock, he said, was practically the last sanctuary of several species of birds.

> "I think a strong movement should be started towards the establishment of sanctuaries with this as the first one to be proclaimed."

He added that members of the civil service had their hands more or less tied by red tape in such matters but those outside the service should get such movements started.[19]

Meanwhile a letter was received at the museum from a resident living near Percé Rock protesting about plans to drive away the cormorants nesting on the Rock. Through discreet enquiries Taverner discovered that this was indeed being considered by the Fisheries Department because the cormorants were thought to be eating the salmon fry which were being cultured in a nearby fish hatchery. Taverner did two things. He wrote to Brock, in his capacity as Deputy Minister of Mines, and warned him what was being planned and the wider consequences that might result from such action. He also told Fleming that the Fisheries Department apparently intended to have men scale the rock and break up the cormorants' nests. In that case, he said,

> "I am going to be on hand when they go up and make a survey of the place before the bloody work begins."[20]

It was a challenge which Percy accepted swiftly. In late May 1914, Taverner and Young arrived in the Bay of Chaleur in the Gulf of St. Lawrence on museum business.

Before settling in the Gaspé vicinity Taverner and Young spent three weeks collecting on Miscou Island in Chaleur Bay, New Brunswick (late May — mid June). Apart from a brief report on field work in the Gulf of St. Lawrence written by Taverner and printed in the "Summary Report for 1914",[21] there also exists a series of twelve letters from Percy to his mother and sister covering the period from the end of May to mid August.[22] These letters give a vivid account not only of his bird collecting but also of the camp life and adventures of Percy and Young, and later of Frank Hennessey, in Pictou, Percé and other places. The entertaining content of these letters combined with Taverner's lively style cannot be properly appreciated in a few short quotations. They deserve to be published in full as a contribution to Canadian travel literature.

The first letter, dated 31 May 1914, was written from their camp on Miscou Island in Chaleur Bay, New Brunswick. The weather had turned cold and it snowed. A few days later there was a memorable

storm, graphically described by Percy, in a letter of 6 June, during which, he said, their "precious bird skins were scattered all over the place, and hammered into the ground and mud with the rain." By ingenuity and determination they salvaged most of the camp equipment, and all except four of the 130 bird specimens. Another problem they had to overcome was caused by the difficulty of travel in that region in spite of local railroad and boat services. Taverner had estimated that they should arrive in Percé about mid June, but they had some difficulty getting away from Miscou caused by weather and steamer timetable changes. Even then to travel by rail round Chaleur Bay took three days with two overnight stops, and eighteen pieces of baggage to transfer six times. As Percy remarked in a tone of resignation "Surely one has to have patience to travel about in this part of the country."[23] Unfortunately the railroad passed a few miles from Percé and they were dumped on a platform in a hamlet called Cape Cove in pouring rain at night. But the drive into Percé by cart next morning was exciting. Percy described the hilly scene as the village of Percé, dotted with pretty white houses came into view and the high ground of Mt. Joly above.

"The next moment Percé Rock burst into view just beyond, coming out from the trees like the prow of a giant ship and forging ahead until full in view — the blue sea showing through the pierced hole` near the stern and the shaft-like column standing isolated in the rear. It was a most impressive sight . . . and around the top was a cloud of white gulls circling and hovering . . . It took our breath away."[24]

Before leaving Ottawa, Taverner was told by James Macoun that he ought to call on the lady from whom the museum first heard of the threatened destruction of the cormorants on Percé Rock. This is how he described his visit.

"I called on a lady who now lives here — a Mrs. James — widow of an artist who built on a cliff face just opposite the rock, and has a most beautiful home with fine colonial interiors filled with articles of vortu — Sherraton chairs, willow ware and luster ware to burn — a Victor with fine records — two white cats — a 3 ½" telescope to study the birds on the rock — a bottle of Benedictine — and home made fruit cake, and a hearty welcome. She is an old lady, and informs me that the winters four nights a week are for bridge from which it is always morning when they get home."[25]

A short visit to Bonaventure Island, just across from Percé village, to see the large Northern Gannet colony on the ledges of the cliffs facing the Gulf of St. Lawrence showed Percy the need for time to study them. He wrote to Brock suggesting that it would be desirable to remain in Percé all the summer to study the cormorants. The next step was to camp on Bonaventure Island in order to take photographs and make a collection of specimens. In a letter of 6 July he described making camp after an uphill climb on a rugged terrain carrying half a ton of baggage. They camped on smooth green sod among spruce trees with large purple irises growing nearby. They slept on balsam boughs, and cooked on a stove fireplace, getting water from a rippling brook. But that was incidental, although very enjoyable. It was the birds that attracted them. It was an exciting challenge as he described it.

"To crawl to the crest of the cliff and lie on our stomach — not a practical attitude but the only way in which one could look with any easiness, and to see a thousand Gannets — birds as large as geese — pure white with cream heads and jet black pinions and long pointed tails sitting unconcernedly on their nests almost within hand's reach — ledge after ledge of them on their nests down three or four hundred feet — the whole face whitewashed with their excrement (odorous) down to the blue sea breaking in great white masses and shreds below. It was a sight indeed, and then when for every bird on the nest there was another in the air sailing in great circles past the cliff — some so close that one could see the color of their eyes, and others lower down, until the air was full of them all passing, passing, passing, in the same direction, then out over the sea and back again to pass again, like the rim of a great wheel or the center of a cyclone bearing a cloud of snowflakes with it."[26]

In the same letter he described where murres and puffins lived — in crevices in deep horizontal cracks in the cliff. Here they laid their eggs which were scattered all along the rocks without any form of nest. The parent birds had the task of keeping their young from coming into the open. Percy described how between boulders they could see many young birds "lined up like soldiers on parade against the rear wall with occasional parents standing guard before like officers. Sometimes one would suddenly make a dash out, knocking its comrades pell mell as it came, and almost into our faces". But they had no success in finding [Atlantic] Puffins' eggs which must have lain in the deepest part of the cliffs. At this point Taverner received a letter from Brock authorizing him to remain and study the cormorants and telling him that the Evinrude motor that he had asked for had been ordered.

After spending just over a week on Bonaventure Percy began the next stage in his field work. He returned to Percé and then went to the town of Gaspé to take a look at the cormorant question from the fish hatchery and the salmon rivers. In his next letter he devoted a paragraph to the adventure he had getting from Percé to Gaspé by train. Because the train was expected to be three hours late various complications followed and he ended up by being driven in a rig by a farmer's daughter to a town a few miles distant. Her name was Clara. This is how Percy described her:

"Great strong girl, brown as a berry, beautiful hair and strong arms and dressed neatly and with open-work stockings. She knew how to drive also, and made the horse go like a man".[27]

In Gaspé he called on Commander Wakeham, in charge of the fisheries of the Gulf, whom he found

living in "a dream of place" which he described in some detail. Wakeham had just returned from the Labrador in the Marine and Fisheries steamer *Princess*. The two men appear to have got on well, and Wakeham offered Taverner "every service in his power". Percy now needed to make a study of the contents of cormorants' stomachs in order to determine the amount of salmon fry they were eating. Commander Wakeham arranged for Taverner, Young and Hennessey to be accommodated in the ample buildings of the Hatchery. Later in July they were collected at Percé by the Commander and taken in the *Princess* to Gaspé. In his next letter Percy wrote:

> "It was a most delightful trip. The steamer is like a yacht, our host was perfect and the chef a genius. We had supper on board and it was a treat. We were sorry when the anchor dropped in Gaspé Basin and our voyage was ended."[28]

The assistants at the Hatchery were only too willing to help Taverner and his assistants to explore two cormorant rookeries in the bay and to obtain some nests. On another day they were taken to the St. John River to see how the fisheries people planted young salmon, which he described in some detail. There was one detail of particular interest when he wrote:

> "We saw lots of salmon in the water — big ones 20 and 30 pounds in weight, but could catch none as the river is under lease to a private American club."

They continued this pleasant life, collecting cormorants and analysing the contents of their stomachs, and studied their plumages.[29] For young Frank Hennessey it was especially enjoyable since he was invited to all the parties and dances. By early August he could write that they had thirty cormorant skins. This was far more than they needed for specimens but they were collected in order to get the stomachs and it was best to save the skins as well.

The war between Germany and various European countries including Britain, and therefore Canada, broke out at the beginning of August. Writing home on 8 August Percy alluded to it briefly and the various rumours about the German fleet, adding rather flippantly: "Perhaps the next time you hear from me will be from a German prison after being captured in the *Princess*." This referred to a short visit to the Magdalen Islands (Iles de la Madeleine) and the Bird Rock. Percy was elated about going to the Bird Rock in a special steamer which he called a "luxury no other birdmen ever had — most of them had to take what passage they could get in smelly fishing schooners". At the end of this letter he tempted fate by writing "I cannot think of any more news now, though when I get back from Bird Rock will probably be loaded with it."[30] Percy should have known better. The next letter, dated 12 August, began "Another disappointment. In a way the fortunes of war. We did not get to Bird Rock." What happened was this. They landed on Amherst Island in the early morning to wait for the mail steamer from Pictou. They were given two hours to collect what birds they could. When the mail boat did not arrive they made for Grindstone Island, expecting the mail boat to catch them there. They set about skinning the twenty birds they had collected at a table between decks. At Grindstone the Fisheries officer, who was also the Customs collector, came aboard. His news was bad. He had received orders from Ottawa to allow no boats to clear for the Gulf because of a report of two German ships near the mouth of the Gulf. The Commander was not bound by this order, being on government business, and referred the decision to Taverner who did not feel like taking the responsibility. Since it was not necessary to visit the Bird Rock he advised returning to Percé. As he wrote "the Bird Rock might wait".[31]

The remainder of the time was spent on visits to Bonaventure Island where they collected a [Black-legged] Kittiwake's nest, and carried out more photography. This time they brought a rope with them and Percy was able to lower himself through a crack deep down into the cliff where it was almost too dark to see. Lying flat on the damp ground, on rough pebbles, and pushing his camera ahead of him, he came out on a ledge filled with puffins and got some good photographs of them at a range of ten or fewer feet. Because he appeared from inside the cliff face the birds showed no sign of fear. Young found a nestling Atlantic Puffin at the back of another crack. Percy described the scene:

> "The ground was strewn with unfertile, unhatched eggs of Murres, now in advanced stages of decomposition, but in he went. Two eggs broke and almost stifled him, but he got the bird, though his clothes were smeared with old egg."[32]

How did they ever get rid of the reek of rotten egg from their clothes? Perhaps they didn't mind since they had achieved one of their prime objects in returning to Bonaventure. Another was to find a young Razorbill but they were too late; the young must have been taken off to sea by their parents. On another visit they expected to spend the night on Bonaventure in order to be ready to catch the photographic light on the bird ledges. They also required some young Petrel [Leach's Storm Petrel], a Northern Gannet's nest, and more photographs (autochromes).[33]

By mid August they were packing up to leave; Percy went to say goodbye to Mrs. James and left us this pen picture:

> "She takes great pleasure in assuming the office of Lady Patroness of the Rock, and delights to entertain visitors to it. Her figure — that of a little old lady, slightly stooped, her arms full of packages and leading a mongrel dog by a strap is a familiar one on the street (road) of Percé."[34]

What, then, was there to show for the work of three men during a three month field trip? What were the results of the Percé — Bonaventure expedi-

tion? The first and chief result was that Taverner, as the ornithological specialist at the National Museum of Canada, had been able to form an opinion, based on research, of the cormorant question: His first impressions were given in a letter to his mother and sister as follows:

> "The Cormorant question is interesting. I always thought the damage they do was exaggerated but not to the extent that the evidence shows. Their effect on the salmon is almost nil. Those in tide and salt water feed almost entirely on sculpin and eels. Those in fresh must eat salmon, but one of their bitterest enemies only admits of seeing 3 or 4 Cormorants up river in a year, so you can see what that means. However I will have an interesting report to write as it touches several phases of the subject that I have always wanted to write about."[35]

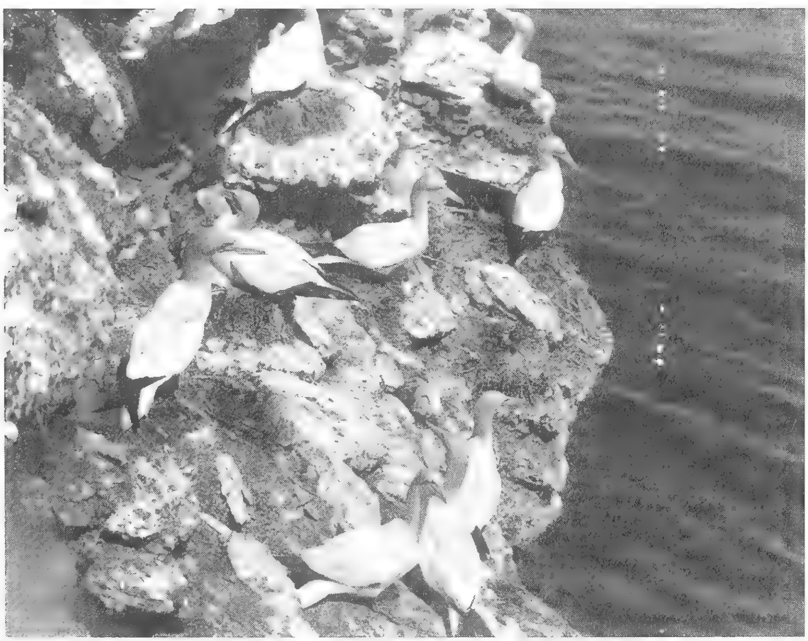
His nature observations were set down in a study printed in the museum Bulletin in April 1915 entitled "The Double-crested Cormorant (*Phalacrocorax auritus*) and its Relation to the Salmon Industries on the Gulf of St. Lawrence".[36] This dealt with the bird's food habits at length. His conclusion, based on data examined, was that they fed almost entirely on species other than salmon, but that they inconvenienced fishermen locally by taking some of the herrings out of their nets. Taverner also took this opportunity to start a study of a colony of breeding Northern Gannets including a collection of his own photographs. This study was to continue the following summer and was eventually published in *The Ottawa Naturalist* in May 1918 at a time when the whole future of Bonaventure Island was uncertain. This article represented his mature thoughts on the birds of Bonaventure Island, especially the Gannets. Finally the expedition was a valuable learning experience for Taverner that did much to increase his self confidence. He matured as a consequence. He realized this when he wrote:

> "This has certainly been a season crowded with ornithological experiences and I am commencing to feel like a veteran."[37]

It also gave a special interest to his correspondence with some of his ornithological friends. Two letters exist between A. C. Bent and Taverner written in December 1914. Bent requested information about Taverner's trip to the Gaspé and the plumage of gannets to be used for his *Life Histories*. Taverner replied that they obtained specimens in all mid summer plumages, and that Hennessey made a considerable number of water colour sketches of the bill, feet, eyes and soft parts of various species of various ages, including the colour of the mouth.[38]

*Bonaventure Island and North Shore of Gulf of St. Lawrence, 1915*

When Taverner returned from Percé in the fall of 1914 he was drawn more deeply into the urgent problems of bird protection and the conservation of bird habitats in eastern Canada. While writing his report on the cormorant problem he also began writing up



Gannets on bird cliffs on Bonaventure Island, 1915. Photograph by P. A. Taverner. (Reproduced courtesy of the Canadian Museum of Nature, number 32273.)

his material on the gannets of Bonaventure Island, and realized that he would need to return to Percé the following summer. The object of the 1915 expedition would be to complete his study of the gannets, to take more photographs of them on the cliffs, and more especially to make a film of breeding Gannets on their ledges and in flight. Such a film would be very useful for educating the public, and rousing support for protecting the gannets at their breeding sites. The experience gained in 1914 would be turned to good account during the 1915 expedition.

Taverner took with him Young, Patch and Johnson. They reached Percé at the beginning of June, and began working the woodlands and shores near the village, with frequent visits to the bird ledges of Bonaventure Island. Patch and Johnson were responsible for the preparation and mounting of exhibition material including specimens. They studied habits and attitudes, took casts and photographs of rocks and accessories for reproduction in life history groups. Taverner and Young gathered additional scientific information and material, taking photographs with autochrome and ordinary plates, as well as taking moving pictures of the bird ledges. Late in June Taverner and Young left in the steamship *Princess* on a three week voyage along the north shore of the Gulf of St. Lawrence, courtesy of the Department of Marine and Fisheries. Patch and Johnson remained at Percé till late August.[39] This is a bare outline of their field work. But fortunately Percy's letters to his family and to Fleming bring the expedition to life.

As soon as Percy got to Bonaventure Island he started taking photos in spite of poor weather — fog or smoke (bush fires) nearly every day. He took with him a graflex camera and with the use of new, fast plates he hoped to improve on the results of last year. He took what he felt were some good autochromes on the ledges and sent the plates off to the museum to be developed to find out if they were satisfactory. As he explained in a letter home: "The exposures are rather long, and with living birds it makes the result rather uncertain." Meanwhile he was entertained by Mrs. James (he had met her the previous summer) who invited Percy, Young and Mrs. Patch to play bridge. Percy reported that Mrs. Patch had been entertained by Miss LeBrun, and was getting into the Percé society. Although it was not extensive it was not to be sneezed at. "These Jersey people are true gentlefolk".[40]

On the other hand Percy was not impressed by the French inhabitants. Apparently a party of eight sportsmen went in early June to Bonaventure Island and shot birds indiscriminately all day. Writing to Fleming he gave a gruesome account of the carnage, and was clearly upset by what he had seen.[41] In a letter to his mother he omitted such details but explained why they acted as they did.

> "Last Sunday a party of eight sportsmen (?) went to the Island and shot all day. They were intelligent looking men too, not ignorant simple fishermen, — but French. How the local English dislike the French, and one cannot blame them. Percé is the county seat of Gaspé Co., and there are a number of French Lawyers and a doctor here. Men of obvious educational advantages, but you would be surprised at their narrowness. To a lawyer I suggested the iniquity of shooting the harmless birds, and he could not grasp any idea of wrong in it, and thought the answer There are lots of them was sufficient justification. But how could they be other than narrow? How can they imbibe modern trends of thought and ideas without reading, and they are confined to the few French Canadian publications which are notoriously under church domination. This is, I think, the real race problem in Canada — getting the French to read English, where they would have the press of all English speaking countries to draw from, and not but the one sided presentations under the control of reactionists or others as circumscribed as themselves."

Percy then gave a detailed description of how the local Catholic Church celebrated the feast of Corpus Christi. He was an interested spectator, watching at a distance.[42]

Commander Wakeham, who had been in command of the steamship *Princess* in 1914, had died in the interval, but the new commander invited Taverner and Young to accompany him on the ship's next cruise in the Gulf of St. Lawrence. They embarked at Gaspé on 27 June. The ship's route was along the north shore of the Gulf as far as Blanc Sablon at the border between Quebec and Labrador by the Strait of Belle Isle, and close to the Atlantic Ocean. The object of the voyage was to regulate the fisheries by issuing licences, and enforcing the regulations. As the route followed the land closely there were daily opportunities for going ashore though little opportunity to explore or collect for any length of time anywhere. They reached Blanc Sablon on 30 June but found ice coming in through the straits of Belle Isle, and were not able to enter the harbour until 8 July. They returned by the same route, making a final short stop at Ellis Bay on Anticosti Island before reaching Percé on 15 July. There is a fairly detailed account of this voyage in a letter that Percy wrote to Fleming in which he said that they were unable to obtain many birds but that he got a good idea of the geography of the coast and poverty of the fishermen living there. Bird information was not his main object on this trip but rather to gather information on people in relation to birds so that he would be in a good position to push for legislation to protect the birds of the Gulf. His first thoughts on this subject were expressed in this letter, namely that the coast was a mass of islands, that it would take an army of game wardens to patrol them, that compulsory gun licences would be the only feasible method. The people, he explained, were so poor that they killed

The wheel of the *C. S. S. Princess*, 1915, from the left: P. A. Taverner, Captain Chalifour, and C. H. Young. (Reproduced courtesy of the Canadian Museum of Nature, number 32351.)

birds to survive, and if it was not for the abundance of eider ducks many would starve to death.[43]

In conclusion Taverner mentioned the more detailed exploration of the same stretch of coast made by Charles Townsend between the end of June and September 1915. Townsend and Taverner had met through AOU meetings, and had corresponded since 1911. He had studied the birds to the east of Blanc Sablon in 1906 and to the westward of Natashkwan [Natashquien] in 1909 and 1912. Now, in 1915, together with a botanist, Harold St. John, he explored the coast in a small schooner. Since he was working in the interest of the National Museum, but was not tied to a strict schedule, Townsend had good opportunities to make a detailed study of bird life there. His preliminary report on the expedition was included in the museum's "Summary Report for 1915" following Taverner's report.[44] Both reports contained remarks on the need to preserve birds in the Gulf of the St. Lawrence.

*The Prairies, the Rockies, and British Columbia in 1917*

Taverner did not undertake any field work during 1916 but in 1917 he and Young were at East Shoal Lake, Manitoba, by mid May. The lake is about thirty five miles northwest of Winnipeg. It had been visited by a number of egg collectors and ornithologists between 1867 and 1912, the best known being Frank Chapman in July 1901.[45] In order to make a representative collection of birds occurring in Manitoba Taverner chose one location and worked it thoroughly. Manitoba is the most eastern of the prairie provinces and is where the interface of prairie and eastern woodlands occurs. As such it is one of the most important areas of geographical distribution in Canada.[46] In mid-June Taverner and Young went to Red Deer, Alberta, where a small boat was built to Taverner's design capable of carrying them and their camp and collecting equipment. With an outboard motor attached they began the descent of the Red River. This entailed a journey of some 217 miles to the southernmost point in the river, well southwest of Drumheller, where they set up their final camp on 19 July near to the Geological Survey's paleontological collecting camp where Charles Sternberg was excavating dinosaurs. They spent nearly a month of the expedition setting up camps along the way from which they made observations and collected specimens. Taverner left Young and continued into British Columbia while Young remained collecting in the vicinity of the camp until late September. The expedition was written up by Taverner with a six-page narrative and an annotated list of the species recorded.[47]

Taverner's next stop was at Banff where there was a small museum. Here he visited the White Museum of the Canadian Rockies and met with some members of the Alpine Club of Canada.[48] He then went to visit Munro at Okanagan Landing where the latter was collecting, for sale, birds, mammals, insects and plants.[49] From there he went to Vancouver Island to see "Professor" Macoun, and then up the coast to Prince Rupert opposite the Queen Charlotte Islands.[50] From there he took the grand trunk Pacific Railway to Hazelton where he spent a few days assessing the bird population.[51] From there he continued by rail to Jasper Park where he joined Jim Macoun in camp beside a small glacial lake below the peak of Mount Edith Cavell. It was here that Percy met for the first and only time the well known collector of that era — employed by the Macouns in their bird collecting — William Spreadborough.[52] Finally, for the period September 17-26 he returned to the same part of Shoal Lake as earlier to obtain an idea of the autumn conditions there and fill some of the gaps left in the spring collecting.

When he reached Ottawa he had been on an extended field trip of nearly five months. It was possible to be away from the museum for so long consecutively because the exhibition material was packed up and much of the building was occupied by the Senate and House of Commons. Most of Taverner's travel was spent on collecting and note-taking, but some of his time was spent meeting people in the world of ornithology as well as museum works. He visited the Provincial Museum of British Columbia in Victoria where he took notes on the bird collection. Wherever he went he made good use of the opportunity to weigh up the value of the local topography for birds, and to meet old or make new acquaintances. He paid his last visit to John Macoun, the grand old man of Canadian botany, while in Victoria and managed to spend two weeks with his son, Jim Macoun, in the Rockies. The meeting there with William Spreadborough was one that Taverner remembered with pleasure even though he never managed to persuade Spreadborough to join him in any collecting expeditions after Jim Macoun's death in 1920. What he wrote about those few weeks in camp in Jasper Park served as a warm tribute to William Spreadborough, the boy from Bracebridge, Ontario, whose collections and observations were "the real beginnings of our national systematic collections and the basis of many scientific papers by specialists."[53] This was how Percy described Spreadborough in camp after a long day of hard work.

> "By day he was afield investigating the most hidden recesses of the mountains or skinning specimens, distributing the by-products of his operations to the Whiskey Jacks momentarily lured from the caribou. In the dark of the evenings it was pleasant to sit with back against a shielding rock or sheltering trunk, feet extending towards the grateful camp fire, listening to William 'reminiscing' from his inexhaustible store of memories of travel and exploration by field and stream. He could go on and on and, being a natural story teller with a photographic memory that forgot no detail, interest was always sustained. His energy was inexhaustible and no mountain was too steep or way too rough for him to face if a desirable specimen were the objective."[54]

During field expeditions Taverner was on the alert to identify every bird he saw and to record in his field notebook whatever he had identified beyond all reasonable doubt. "No record", he wrote at this time, "is absolutely unassailable until specimens are secured and examined by competent authority".[55] Anything unusual he saw concerning such things as plumage, behaviour and migration he recorded in notebooks. When writing letters to his friends during these expeditions he discussed what he thought would interest them, not only about birds and plants but also about the people he met in his travels. His tales were mainly of birds and men.

*Exploring in Ontario 1918 and 1919*

Taverner had intended to visit Mitchell in Regina during 1918 to discuss with him the best area in

C. M. Sternberg's field camp, Red Deer River, Alberta, 1917. Standing: Dr. R. L. Rutherford (University of Alberta), P. A. Taverner, C. M. Sternberg, C. H. Young, C. H. Sternberg, Dr. J. A. Allen (University of Alberta), three unidentified assistants are seated in foreground. (Reproduced courtesy of the Canadian Museum of Nature, number 40000.)

Saskatchewan for an expedition in 1919, as well as to collect in the prairies. But he was forced to change his plans. In a letter to Fleming he explained what had happened:

"Parliament was so late in passing supply bills, you know that they never bring up an appropriation bill until the last thing when everybody is too anxious to get home to discuss them, that the western trip was not worth while. Instead of that I planned a short trip along the Rideau Canal to Kingston to get better acquainted with local conditions and relationships."[56]

In a rowboat with an outboard engine with a canoe in tow, and accompanied by a man from the taxidermy shop, he set off on 11 June. On the day they left the weather turned cold and continued with rain and wind all the time, only clearing just as they returned to Ottawa on 15 July. Since then, he told Fleming, the weather had been roasting. They must have looked an odd sight, huddled up in waterproofs sitting low in the water in a rowboat, trying to find birds in the rain in the middle of the summer on the Rideau Canal, river and lakes connecting it. The result was minimal — just over 100 species recorded, the best bird seen a Least Bittern, and the observation that the marshes of Smith Falls were particularly good for hunting. As though this experience was not enough Percy spent two weeks with Clyde Patch with similar equipment exploring the Ottawa river as far as its mouth, this time in better weather but with disappointing results. Writing to Brooks he put the best face he could on the expeditions. He said that although they did not find a large number of birds they managed to fill a few holes in their local collections, and obtained considerable information on local conditions, and therefore it was worth while. One conclusion he came to may have been of slight interest at the time when he wrote: "I think there is quite a migration route up the Rideau system but none at all on the Ottawa [river] below here."[57] All in all these boating trips round Ottawa in 1918 were something of an anticlimax after the achievements of the previous summer.

In the spring of 1919 Taverner suffered the same frustration over his plans for an expedition to the west as in the previous year. By mid May he still had not left. He told Fleming that everyone was waiting for the word to go or stay; meanwhile the birds were migrating "but no one cares except us".[58] Eventually it was too late. Instead Taverner took advantage of

the newly opened stretch of the Canadian Northern Railway from Cochrane westward to Kapuskasing. Accompanied by Claude Johnson he spent three weeks in Kapuskasing district making a representative collection of summer breeding birds in a northern Ontario forest area that had recently become accessible. Kapuskasing at that time was a "model town" mainly consisting of a prisoner-of-war internment camp and a Dominion Experimental Farm, and an Ontario government Soldiers' Settlement Project. Letters from Percy to his family, if he wrote any, have not survived, but letters to friends give some details. He wrote Fleming an account of this trip during which he collected a fair number of specimens including a Richardson's Owl [Boreal Owl]. Lincoln's Sparrow and Mourning Warbler were found to be abundant breeders near Kapuskasing.[59] Taverner used his own design of field notebook on all his field trips, and the ones for the Kapuskasing area are an example of what these were like. Thus volume 1, bound in red, contains eight pages of typewritten notes, together with photos of their camp, which provide some information about the trip itself. Species lists are in part of volume 1 and all of volume 2. These are the expeditions and shorter trips which Taverner managed to undertake between 1913 and 1919.[60]

There was one expedition, supported by the Geological Survey, for which Taverner was invited to find an experienced field naturalist. This expedition was to be led by Charles Camsell, "Geologist in charge of Exploration" of the Geological Survey, who planned to make a canoe traverse from Lake Athabasca to Great Slave Lake in 1914. The object was to observe the geography, geology and biology along the route. Since only three canoes and seven men were being taken it would be impossible to bring out skins of birds and mammals. The naturalist chosen, therefore, would have to be capable of taking reliable notes of the wildlife seen. Taverner first asked Brooks who declined, and then Munro who also declined. Taverner next asked Fleming's advice. They came to the conclusion that there were no other Canadians with suitable qualifications for the job, and available to spend from May through September on the expedition.[61]

Taverner now started searching for an American naturalist with the right qualifications. His contacts in the AOU were useful in this search. Eventually Dr. Arthur A. Allen of the Cornell University Zoological Laboratory suggested a suitable man who was keen to go. This was Francis Harper who had recently obtained a degree in biology at Cornell University and was now with the Brooklyn Museum. After travelling over land from Edmonton to Athabasca Landing and down the Athabasca River to its mouth, in May and June, Camsell and party left Fort Chipewyan on the northwest shore of Lake Athabasca in late June 1914. From the middle of the north shore they started their traverse towards Great Slave Lake, by way of Lake Tazin, and the Tazin River to its junction with the Taltson River. From here they went down the Taltson reaching Great Slave Lake early in August, a distance of about three hundred miles. They then followed the south shore of Great Slave Lake to the small trading post of Fort Resolution. From there they paddled up the Slave River to Fort Smith, a distance of two hundred miles, in ten days. Here Harper was supplied with horses and, together with the buffalo guardian, made a six day trip into the wood buffalo country. By mid-September the party had returned to Fort Chipewyan.[62]

Harper wrote a biological report of the expedition for Taverner who included it with his own report in the Zoology Section of the Geological Survey's "Summary Report for 1914".[63] Harper noted 85 species in the region between June and late August among which the following were considered by him as interesting records: Short-billed Gull [Mew Gull] nesting by the north shore of Lake Athabasca and during the traverse, a range extension southward for that time;[64] Arctic Tern; and Hutchins' Goose [Canada Goose] on the Taltson River where four young were taken;[65] several records were received of Whooping Crane being in a locality they passed through; an estimated 700 or more Stilt Sandpiper in the Athabasca delta in early June; a single Rock Wren at Fort Chipewyan in mid June. Harper collected 93 specimens of birds and took over 450 photos of topography and vegetation.[66] For Taverner this expedition brought back useful information on the north westernmost part of Saskatchewan, the north easternmost tip of Alberta, and a small part of the Northwest Territories south of Great Slave Lake. A selection of the specimens taken by the expedition was a welcome addition to the National Museum collection.

## CHAPTER 9. Bird Protection

The origins of bird protection in North America go back to the first half of the nineteenth century when a few sportsmen realized that game birds were beginning to grow less numerous in their own localities. By mid-century several sportsmens' organizations had been formed in various states for the preservation of game. These were active in their state legislatures to secure laws to protect game. During the second

Taverner in an open boat with an outboard engine while exploring the Rideau waterway system between Ottawa and Kingston in search of birds in June 1918. (Reproduced courtesy of the Canadian Museum of Nature, number 44460.)

half of the century the fashion of decorating ladies' hats with bird plumes caused the millinery trade to buy large quantities of plumes from sea birds to Hummingbirds as well as various species of tropical birds. By 1883, when the American Ornithologists' Union was founded, the need to protect non-game birds had become urgent. A campaign was started to educate public opinion, data on the plumage trade was collected, and work for bird protective legislation on a national scale was begun.[1]

The term "Audubon Society" was coined by George B. Grinnell and first used in his magazine *Forest and Stream* in 1886, while at the same time the AOU organized a Committee for the Protection of Birds. However, it took ten years to rouse sufficient support to make the work of these two organizations effective. In 1900 the AOU Committee decided to protect breeding colonies of gulls and terns by means of guards. The money with which to pay them was given by a private individual. To this action can be traced the beginning of the Sanctuary idea in America.[2] In 1904 a "National Association of Audubon Societies for the Protection of Wild Birds and Animals" was formed. By the first decade of the twentieth century public interest in bird study had developed rapidly with the publication of books of a popular nature such as Frank Chapman's *Handbook of Birds of Eastern North America*, first published in 1895 and reprinted regularly thereafter, and Chester Reed's *Bird-Guides*, specially useful for beginners, in 1906.

Meanwhile the Federal Government, prompted by the AOU, had established a government office of Economic Ornithology in the U.S. Department of Agriculture in 1885 which became the Bureau of Biological Survey in 1905. This office issued reports dealing with the food habits of wild birds, their economic status and laws for their protection. These reports were available to the public on written application and Taverner made use of this service while living in Detroit. The effects of the information contained in these publications on conservation groups, on government officials and politicians were consid-

erable, and probably contributed to the first federal measure aimed to protect birds — the Lacey Act of 1900 (amended 1909). This act was designed to curb the bringing of foreign wild birds into the United States. Another act, passed in 1913, was aimed at bringing under federal control birds that migrate twice a year between different states.

Eventually the principles of this act became the subject of a treaty between the United States and Canada.[3] Because Taverner lived in Michigan during the decade 1900-1910 and was an active ornithologist in touch with the Bureau of Biological Survey, the AOU, and an avid reader of journals and books he knew about developments in the wild animal protection movement. When he came to Ottawa in 1911 he not only had up-to-date information on the subject, he also had acquaintances among some of the leaders of the movement in the United States.

In Canada, however, serious concern over the protection of wildlife had only been developing since about 1890. During the first half of the nineteenth century the impressions one gets from bird notes that have survived show that many species were quite abundant. Charles Fothergill kept systematic notes on birds seen along the north shore of Lake Ontario between Port Hope and Toronto in the period 1816-1840. He mentioned a total of approximately 180 species in his manuscripts, most of which were shown as relatively abundant.[4] During the second half of the nineteenth century some people in the more settled areas began to realize that game bird populations were in decline. One example was the Wild Turkey in south western Ontario which was said to be fairly abundant in the Lakes Erie and St. Clair regions in the 1860s. But the Ontario Game and Fish Commission in its 1872 report predicted its extinction in Ontario which, in fact, happened by 1904.[5] Non-game birds were also beginning to feel the pressure of increased hunting combined with loss of suitable habitat. The best known example of this was the Passenger Pigeon which was still very abundant in Ontario in the 1870s but in the 1880s suffered a drastic decline throughout its range.[6] The Ontario government set up a Royal Commission to review the wildlife situation in the province. Its report, published in 1892, and based on the evidence of many sportsmen, stressed the decline in numbers of various birds and mammals, some of which were thought to be on the verge of disappearing. As a result Ontario established a Game Protection Act in 1893, while similar measures were established by British Columbia in 1895, Quebec in 1899 and Manitoba in 1900.[7] At that time in Canada protection of wildlife was considered a provincial matter to be regulated, if at all, mainly in the interests of sportsmen and farmers. The myth of superabundance, and the belief in the duty of government to aid the exploitation of all natural resources had moulded the federal government's attitude to wildlife. The first Dominion park to be established by the federal government was Rocky Mountains Park at Banff in 1887. Although the motives of the government were not in creating a wildlife preserve nevertheless "the very wording of the Act went a long way towards establishing, in theory at least, the principal of wildlife protection".[8] As Janet Foster clearly shows in her study *Working for Wildlife: the Beginnings of Preservation in Canada*, during the twenty five years between 1887 and 1912 a few senior civil servants in departments most concerned with wildlife "turned their own goals of wildlife preservation into government policy". When James Harkin was appointed Commissioner of Dominion Parks in 1912 he had "a clear and unfailing vision of what wilderness, parks, and wildlife signified for the Canadian people...".[9] Percy Taverner arrived at the newly opened Victoria Memorial Museum in Ottawa just at the time when the federal government, prodded by a few senior civil servants and the nucleus of a public opinion, was about to become seriously involved in wildlife conservation. His arrival was extremely opportune.

In 1909 a bill was passed in Canada to establish a Commission of Conservation which would be separate from the machinery of government. Although it would report to Parliament through the Minister of Agriculture it would be responsible only to Parliament as a whole. It was intended that the Commission should be "an independent... and fully non-partisan body that would explore all questions pertaining to natural resource conservation in Canada."[10]

In 1911 Parliament established a Parks Branch under the Department of the Interior to manage and develop national parks. The appointment of James Harkin as Dominion Parks Commissioner was a significant step forward that would result in greater protection of parks and wildlife throughout Canada.[11] Several things occurred in 1913 to start a train of events that would result in far reaching changes in the protection of birds in the next few years.

The Commission of Conservation held its annual meeting in January each year and subsequently issued an annual report. At the January 1913 meeting J. Walter Jones, who had been asked by the Commission to report on fur farming in Canada, pointed out the changed conditions in regard to natural resources since the passing of the British North America Act in 1867 when natural resources were placed under provincial jurisdiction. For example, he asked, "what legislative body should have charge of migratory birds?" This was an important question since the Weeks-McLean bill was before the United States Congress. A copy of the bill was published as an appendix to the 1913 Report.[12] Soon after the Commission's meeting Maxwell Graham, chief of the Parks Branch Animal Division, sent a memo to Harkin suggesting that the time was suitable for leg-

islation by which migratory birds could be protected.[13] Graham next wrote to James Macoun for information that would corroborate what he had told Harkin, and Macoun passed the letter to Taverner to answer.[14] Taverner was in a good position to give information on the need to regulate spring shooting by an international agreement. He also gave some estimate of agricultural losses in Canada because many species of insect-eating birds were being killed legally in the United States, but recommended Graham to obtain information from the U.S. Biological Survey which had been collecting biological data since 1885.[15] Harkin meanwhile wrote to the secretary of the American Game Protective and Propagation Association about the Weeks-McLean bill saying that it was felt that Canada ought to cooperate with the United States in protecting species of birds which migrated between the two countries.[16] About this time another senior civil servant in Canada involved with wildlife, Gordon Hewitt, Dominion Entomologist with the Department of Agriculture, wrote to the Chief of the United States Biological Survey. He wrote as a private citizen interested in bird preservation, and asked for information on the Bill for Federal protection in the United States. He also suggested that Canada and the U.S. should find a way to cooperate in protecting birds. As a result he was sent material relating to the Weeks-McLean bill then before the Senate.[17] Harkin now wrote to Fleming and Saunders asking whether there was a need to protect migratory birds in Canada.

After his return from the Point Pelee expedition of 1913 Taverner became more and more involved in the question of wildlife protection through the Commission of Conservation and its secretary, James White.[18] The Commission of Conservation was already gathering information on twelve or more issues one of which was about the need for animal sanctuaries on the North Shore of the Gulf of St. Lawrence. An address on this need was presented at the Commission's annual meeting in 1911 by Lt. Colonel William Wood, a resident of Quebec province, who had firsthand experience of the situation. Wood sent a copy of his address to many scientific journals, and to a number of prominent men who realized the need for conservation of wildlife, requesting their comments. From their replies he prepared a report which was published in the Commission's report of 1912.[19] This was a detailed review of the situation in the Gulf of St. Lawrence together with endorsements of several prominent people. For example Dr. John M. Clarke, Director of the New York State Museum, who had made repeated visits to the coast of the Gaspé and the islands in the gulf, reported that on the Magdalen Islands there was a wide variety of shore birds during the summer months. These were supposed to be protected by law but the law was not in the least respected by hunters. They knew they were too far away from authority to be prosecuted. The islands, he said, were also known to students of birds from the United States who were guilty of collecting shore birds for their skins, and for their eggs, during the breeding season. On the Bird rocks one American oologist was known to have taken 369 clutches of eggs. On Bonaventure Island, where the birds were not protected by law, shooting at birds "to stir them up" was not unusual. On Percé Rock the same temptation to "the man with a gun" existed but the people of Percé, he said, were so attached to the birds that no one would ever think of killing one. Napoleon A. Comeau, author of *Life and Sport on the North Shore*, who had fifty years of practical experience in the *North Shore* area as a trapper and student of birds, maintained that it was strangers and so-called sportsmen who were responsible for killing birds unnecessarily, not the local people. Commander W. Wakeham of the Canadian Department of Marine, who had witnessed the destruction of shore birds and sea birds on their nesting grounds in the offshore islands, suggested that certain groups of islands, or even certain sections of the north coast, should be set aside as bird sanctuaries. He also reported on the stupidity of setting aside part of the interior of the Gaspé peninsula as a park without providing any form of protection for the birds and mammals there. Wood wrote sections of the report on laws, leasehold and sanctuaries to place the issues in perspective and set out recommendations.[20] Whether Taverner received a copy is not known. However, from early 1914 Taverner was involved at an official level in making investigations at Percé and Bonaventure into the effects on salmon fry of predation by cormorants and gannets.[21] From this time until 1919 Taverner was in correspondence with James White on the subject of bird protection. In the fall of 1914 Taverner had a talk with Harkin about the idea of establishing a national park at Point Pelee and sent him a memorandum on the subject in December.[22] At the sixth annual meeting of the Commission of Conservation in January 1915 Dr. John M. Clarke spoke about "Protection of the Sea Fowl of the Gulf of St. Lawrence", Gordon Hewitt, Dominion Entomologist, gave a short talk on "The Protection of Birds", while Taverner presented a memorandum on the "state of wildlife at Point Pelee, and at Percé Rock and Bonaventure Island with recommendations that these three be included in the National Park system of the Dominion."

In his memorandum Taverner first described the natural aspects of Point Pelee followed by the economic aspects and ownership. Lastly he discussed the wildlife aspects of the marshes where, he stated, "the place has been over-shot and under-protected and nothing done to attract game". He recommended that the marshes be established as a bird sanctuary, and that the few privately owned lands on the point be acquired

and the whole area be made a national park and bird reservation. He then described Percé Rock through the eyes of a naturalist-photographer with the innumerable gulls and cormorants on it during the breeding season. He ended with a plea for its preservation:

"Such a national monument should be enrolled immediately among the nationally owned wonders of the Dominion, for then, and not until then, can we be certain that its beauty will not be sacrificed to private greed, and that it will remain to be a joy and an inspiration to the people of the Dominion forever."

Finally he described the estimated 7500 Northern Gannets nesting on the rocky ledges of Bonaventure, and recommended that Percé Rock and the Birds' ledges of Bonaventure Island be included in the national park system, and that a resident of Bonaventure Island be appointed warden at a nominal salary to see that the park regulations were enforced.[23] Taverner had now stated the case for preserving these three outstanding bird habitats. From this action various developments followed.

Early in February 1915 Taverner had a long talk with Harkin, Commissioner, National Parks Branch, who told him that the Minister of the Interior had approved of his suggestion in principle. But since there was no money at that time for buying out the settlers at Point Pelee it would have to be deferred till a more favourable time.[24] The next task for Taverner, Saunders and others, who wanted to make sure that Point Pelee and Percé-Bonaventure were preserved, was to bring the issue to the public through the use of films, slides and public talks. That was why Taverner, with two assistants, returned to the Gaspé in 1915.

Late in that year Saunders was in Ottawa speaking before the Commission of Conservation on bird protection. In a letter to Fleming, Taverner described Saunders as

"a delightful speaker. He has a homely confidential manner that is most attractive and convincing. He made a hit. We are bringing him back in March to show our moving pictures again to the Forum and the Ottawa Naturalists. The Bonaventure Island pictures were shown the other day and I was delighted with them. They have aroused a good deal of favorable comment."[25]

Taverner also made known his concern for bird protection on the north shore of the Gulf in his "Summary Report for 1915" which was a handier source of reference for a wider public than the Commission of Conservation report. He referred to the research of Dr. Charles Townsend, who, with a botanist, cruised along the north shore coast of the Gulf in a fishing schooner for several months in 1915. In his own report Townsend emphasized the urgent need for effective bird protection on that coast before it was too late.

"Bird reservations or refuges watched over by guardians will alone save the remnants from extinction".[26]

Taverner commented that the alarming conditions described by Townsend, which threatened the existence of the eider ducks and larger birds, were by no means exaggerated. Taverner therefore urged that steps be taken immediately to conserve these valuable species on the north shore of the Gulf and on the Labrador coast.

"It is more than an aesthetic or academic question in this region. It is more than a matter of game supply for the sportsmen. The sea fowl on the Labrador coast are almost a necessity of life to the inhabitants and furnish practically all the animal food available."[27]

Taverner did not rely on written reports only but was regularly in touch by letter with James White at the Commission of Conservation. Writing from Percé in June 1915 he described to White the conditions on Percé Rock and Bonaventure Island, and along the north shore of the Gulf of St. Lawrence where he found the game laws a dead letter. Taverner suggested that all fishermen should have gun licences on board before a fishing licence would be granted, and that all the officers of the Fisheries Service on the coast should be made game wardens. In a letter of early September he sent White a letter and photographs he had received from Charles Townsend about the bird conditions. In the same letter he suggested that the Commission should call on Townsend to discuss this subject at the meeting of the Committee on Fisheries, Game and Fur-Bearing Animals in early November 1915.[28]

Taverner was severely handicapped in not being able to make public speeches nor chair committees. If he had not suffered from a stammer his sense of humour, wit and lack of pomposity might well have made him an effective speaker in the cause of conservation. Instead he had to put his ideas into writing and leave speaking to others. Apart from W. E. Saunders there was another man who spoke effectively in support of conservation, a man who had turned from hunting birds to working for their protection. The story of Jack Miner, and how he started banding ducks and Canada Geese at his family brickworks at Kingsville, Ontario, is too well known to need retelling.[29] But popular accounts of his early years as a bander and advocate of private bird sanctuaries have failed to place Miner's work in the context of the pioneering work of others in the United States and Canada. As the conservation movement developed it gave momentum to the interchange of information and cooperation among professional natural scientists and amateur field naturalists in both countries. Miner started his interest in conservation through his association with a group of local sportsmen. By the beginning of the twentieth century the decrease in the number of game bird species in eastern Canada was becoming obvious. Miner's home was situated in Essex County in southernmost Ontario near the north shore of Lake Erie between Windsor and Leamington. In 1904 this group of sportsmen organized the South Essex County Wildlife Association in an effort to prevent the

decline in the number of game birds. While Taverner, Saunders and other members of the Great Lakes Ornithological Club were compiling data at Point Pelee from 1905 onwards Miner started experiments in banding ducks in a pond on his family brickworks. His first bands may have been made by Taverner and given him by Saunders.[30] Saunders and Miner were likely to have been in touch with each other by this time.[31] Saunders first visited Point Pelee in 1882, and in the same year produced a "List of the Birds of Western Ontario".[32] The following year he was elected a member of the AOU at its first regular meeting. By 1900 he was in touch with sportsmen and naturalists in a wide area radiating from his home in London, making friends, and passing on information and new ideas. Saunders and Taverner visited the Miner home in 1909 or 1910.[33] Miner put his first band on a bird in December 1909 when he tagged an American Black Duck which was shot in South Carolina on 14 January 1910.

Miner's major contribution to the conservation movement in eastern Canada at this time (1910-1920) was to apply the principle of bird banding to waterfowl, in particular to Canada Geese. He was the right man in the right place at the right time because his family owned land on which there already existed two ponds suitable for attracting and banding on a large scale. These ponds were also close to Lake Erie so that the geese could fly from the lake where they spent the night, to the Miners' ponds, where they were fed. Miner's experience as a hunter helped him to succeed in attracting them after earlier setbacks. When he found that local hunters waited for the geese to fly to his ponds in order to shoot them, he got the family property declared a wildbird sanctuary. From 1915 he was banding Canada Geese on a large scale and his success was assured provided that he could manage to feed an ever increasing number of geese with corn. In order to raise money to buy more feed be began to give talks to groups and organizations about his work, and the need to set up more sanctuaries for protecting wild birds of various species, not only geese. In 1917 the government of Ontario declared the Miner farm a provincial Crown game reserve which gave it status and some financial support.[34]

Throughout the period 1915-1920 Taverner made certain that White was supplied with up to date information on the problem of bird conservation in the Gulf of St. Lawrence, sending him copies of letters and articles by Townsend on the subject. In 1916 Taverner sent White a manuscript copy of a chapter on "Bird Conservation in Labrador" from a forthcoming book by Townsend, called *In Audubon's Labrador*.[35] In asking Townsend's permission to have it published in the next Report of the Commission of Conservation he explained that

> "the Commission is a live organization and get[s] things accomplished in a manner that few others can touch. They get their stuff in most presentable shape and though we regard them more or less as thieves giving little credit and stealing whatever they want in their work they certainly get results."[36]

The Canadian Commission of Conservation played a major role in bringing authorities in Canada and the United States together from 1913 onwards to discuss the possibility of the two countries signing a treaty for the protection of migratory birds, many of which were threatened with extinction. When William Haskell, legal counsel for the American Game Association, came to Ottawa in January 1914 to speak on the wildlife conservation movement in the United States he included in his talk a brief outline of the legislative struggle for bird protection in the U.S. to that date. He emphasized the importance of the benefits that Canadians would obtain through such protection. The Commission asked the provinces to call on the Dominion government to get Great Britain and the United States to negotiate a convention for a treaty. Shortly after this the United States government sent a draft treaty for the protection of migratory birds to the Canadian government for consideration. Copies of the draft treaty were passed to the provinces, and all but British Columbia and Nova Scotia agreed to the draft terms. By the spring of 1915 an order-in-council was passed agreeing to the principle of international protection for migratory birds. It took another year of compromise between the Canadian and American negotiators before the objections of provinces and states were sufficiently met. On the Canadian side it required all the energy and skill of Hewitt, Harkin and Graham in negotiation to reach a revised order-in-council that the Canadian government could accept. A Treaty for International Protection of Migratory Birds was signed in Washington by the British Ambassador on behalf of Canada and by the United States Secretary of State.[37] A full year was taken up by the ratification of the treaty by Canada and the United States. When members of Parliament were assured that the provincial governments were in full agreement, the bill passed the House of Commons and the Senate, and received royal assent on 29 August 1917. Owing to problems related to the U.S.'s entry into the First World War the bill was not passed by Congress and the Senate until June 1918 and finally became law when signed by President Woodrow Wilson on 3 July 1918.[38] Protection was afforded to migratory game birds, insectivorous birds and migratory non-game birds. But raptors and crows were omitted from the act. This was an accepted thing at that time since many country people regarded such birds as vermin. But the non-protected status of hawks and owls was to cause Taverner a great deal of trouble later.

Although Taverner was not directly involved in the negotiations of the treaty he was involved in a movement to educate the public in the value of birds, and the importance of protecting them through regulations that could be made enforceable in the

provinces. Writing to Swales in November 1915 he mentioned that he was trying to influence the Conservation Commission in some protection measures.[39] One way of arousing public interest was by showing slides and films of wildlife and habitats that carried a conservation theme. In a letter to the secretary of the AOU he said the museum had two films of the Gannets of Bonaventure taken by Taverner, and one film of the wild geese at Miner's sanctuary. Taverner added that Saunders was willing to speak about them both at the coming AOU meeting at Portland, if they could be included in the program.[40]

The extreme slowness in putting the protection of birds into action in North America can be attributed to the trauma of the final year of the First World War. With the signing of the armistice in November 1918 the Canadian government, at the federal and provincial levels, began to take action. Early in 1918 Taverner was being consulted by Hewitt on bird protection matters and the setting up of new federal regulations in accordance with the treaty. In a letter to Fleming, Taverner enclosed a preliminary copy of what was being discussed and explained:

> "The main idea is to reduce the open season on everything to 3 ½ months as the treaty calls for, to keep the seasons similar as possible on all similar classes of birds and to depart from present provincial seasons as little as possible. British Columbia is the only province that did not come into the agreement and maintained its independence of action in matters of detail. It agreed only to the principle, consequently the many B.C. exceptions. In discussing it, which we have only done partly as yet, a few minor changes have been made, more clearly indicating the tidal regions of P.Q. and allowing Indians to kill certain species for human food. What is the worst puzzle is the regulations thrown about collectors' shipments."

Naturally he told Fleming what was being suggested as regards regulations governing shipments of birds sent to collectors in Canada from abroad which could not be allowed to enter without a special permit.[41] He asked Fleming to send his suggestions on what he would use as "scientific advice" on the issuing of permits. Taverner attributed the fact that Hewitt was now consulting him on bird protection matters to his new status as a Fellow of the AOU. Whether this was true or not, it throws some light on Percy's feelings about his own position at the museum. An Advisory Board on Wild Life Protection had been created in December 1916 with responsibility for framing policies covering wildlife protection in Canada. It was composed of five senior members of government departments concerned with wildlife: James Harkin, Parks Commissioner; Gordon Hewitt, Dominion Entomologist, Department of Agriculture; James White, Secretary, Canadian Commission of Conservation; Rudolph Anderson, Zoologist, Geological Survey; Duncan Campbell Scott, Superintendent-General of Indian Affairs.[42] There were strong reasons why Taverner should be included on the Advisory Board and several reasons why Anderson should, especially since much of the advisory work was concerned with the protection of mammals, and a knowledge of wildlife and human conditions in the Mackenzie Delta of the Northwest Territories was especially needed. There was concern over the decline in numbers of Muskox and barren ground caribou and the effects of this decline on the livelihood of the eskimos.[43]

Taverner would have grounds to feel upset if Hewitt continued not to consult him on the conservation of birds. However, by the end of 1917 he had begun writing to Taverner for information. His first question concerned the state of the duck population in British Columbia. Taverner answered it as best he could but had little firm information. He did, however, explain the relation of the cycle of the rabbit population to the decline in the game bird population, especially in the grouse species. When the rabbit numbers declined, he said, the large owls and [Northern] Goshawks depleted the Ruffed Grouse, Sharp-tailed Grouse and [Greater] Prairie-Chicken.[44]

Hewitt also asked for Taverner's advice on a wider subject. By this time the Advisory Board on Wildlife Protection had been able to agree to dates for open seasons on wild fowl in all provinces except British Columbia. Hewitt sent Taverner the dates suggested through discussion with Francis Kermode, curator of the British Columbia Provincial Museum, for open seasons in northern and southern B.C., and asked Taverner for his comments in the light of any records that he had on migration and other subjects. This gave Taverner opportunity to inform Hewitt of the research he was carrying out, though he regretted how little accurate information he had on the movements of birds in the far west of Canada. He also discussed the question of whether the killing of large raptorial birds should be encouraged in order to protect game birds and poultry. This was a complicated problem in Taverner's opinion. Based on his experience in the prairies during last summer (1917), Taverner said, he was amazed at the number of gophers that Red-tailed, Rough-legged [probably Ferriginous, as Rough-legged Hawks are not in the prairies in summer] and Swainson's hawks killed. Bearing in mind the great damage that gophers do to grain crops great care should be taken not to awaken any more animosity than already exists against these raptors that prey on them. The gophers go into hibernation early in the fall and only then do the hawks begin to take game and poultry. Even then, the buteos migrate from the prairies during the winter, while the [Northern] Goshawk and the Great Horned Owl tend to move south into more settled areas during the winter months. These, in Taverner's opinion, were the only raptors that should be considered as doing serious harm to poultry and game, and he offered this advice:

> "The only safe proceeding is to educate the farmer to discriminate between helpful and harmful species. The

fact of the matter is that it is as much a farmer's bounden duty to learn his bird friends from foes and to know the weeds from his crops."

He would like very much, he said, to write a paper on these large birds of prey and accompany it with descriptions and pictures by which the raptors could be easily differentiated.[45]

Writing to Fleming at this time he gave his opinion of Hewitt, saying

"Hewitt is in many ways a good man. He has great influence and energy and now that he has shown some tendency to seek advice from proper quarters he can be of great value. It is good that there is someone of his calibre to push things."[46]

Brooks, back from the war, wrote to Taverner in September 1918 about the permit system for the young bird collector, and said there would be no young field naturalists in Canada in the next generation.

"As Dr. Merriam puts it the Universities are producing a school of section-slicing and tissue scratching laboratory workers".

Taverner replied that he was fighting for the collector all the time, and described how permits were granted and the regulations that existed for those receiving them.[47]

The next move forward in wildlife protection came in December 1918 when Hoyes Lloyd was appointed "Ornithologist" with the Parks Branch to administer the Migratory Bird regulations under the Convention Act (on his appointment see Chapter 7, page 76). Taverner was much encouraged by this development, as he told several of his ornithological friends. When writing to Swales he mentioned the hard work he had been doing to turn the Ottawa Naturalist into a presentable publication which would fill a long felt want.

He continued:

"We have a new ornithologist in Ottawa now, Hoyes Lloyd, probably you have seen his name in the Auk. He is a protege of Fleming. He has come to the Dominion Park Branch to have charge of the enforcement of the Migratory Bird Convention. I guess it is about the first time an ornithologist has been made Game warden. I think he will be a good man too. His ornithological experience is not very great but he has the proper spirit and understands the ornithologist's viewpoint. Behind him is a Wild Life Protection Advisory Board composed of two good zoologists, Anderson and Hewitt, a representative of the Indian Affairs who is amenable to reason and the Commissioner of Dominion Parks [Harkin] who has direct charge of the Act's enforcement. He is broader than most bureaucrats and has at last realized that we bird men have not got private axes to grind. All told I think it looks good. It is also good to have some one to talk bird[s] with once in a while."[48]

It was ironic that Taverner, who was appointed mainly on his experience as an ornithologist, should not have been given the title of Dominion Ornithologist officially, but that Hoyes Lloyd, who was primarily not an ornithologist, should be called "Dominion Ornithologist". At first his responsibilities were to ensure that the provisions of the Migratory Birds Act were put into effect. After a year his title was changed to Supervisor of Wild Life Protection in Canada. At this time (1918) the concept of ornithology was not well understood by many people. Academically ornithology meant a branch of zoology studied by a specialist on birds. However, no formal courses in ornithology were offered in Canadian universities, and only a few in the United States. Although provincial governments gave official recognition to the field of ornithology, the federal civil service did not have even an accepted definition of what an ornithologist was.[49] Taverner was pleased with the appointment though he gave the government only faint praise for it. In a letter to Bishop he wrote:

"I think Canada has made a record in appointing a bird man in sympathy with the collector and scientific procedures as sort of federal Game Warden. Our new man who will have the details of enforcing the Migratory Bird Convention seems to be an admirable appointment. Sometimes the government does the right thing by mistake. Hope the promise of intelligence develops."[50]

Lloyd appointed three experienced ornithologists as Federal migratory bird officers: Robie W. Tufts in 1919 to be responsible for the Maritime Provinces; Harrison F. Lewis in 1920 for Quebec and Ontario; and James A. Munro for the four western provinces, also in 1920. Wardens were appointed to work under them.

The Migratory Birds Convention Act gave a measure of protection to birds during the spring and fall migrations but more specific protection was required by certain species during the breeding season. Migrating wildfowl such as geese and ducks, birds that nested in colonies, such as herons in trees and seabirds on rocky islands and cliffs all need special protection from human predation and disturbance. The idea of setting aside specific areas as wildlife sanctuaries, or reserves, where birds would learn to feel safe from attack by hunters and egg collectors was not new. The first bird sanctuary in North America had been created in 1887 in the Northwest Territories of Canada (present-day Saskatchewan) at Last Mountain Lake, fifty miles northwest of Regina. The islands and eleven miles of shoreline were withdrawn from settlement and set apart as a breeding ground for waterfowl. In the United States bird sanctuaries were being set up from 1900 onwards. In Canada Jack Miner's experience in banding wild geese at his family brickfields near Leamington led him to seek provincial government support in declaring the area a sanctuary to migrating duck and geese.[51] As regards Point Pelee Taverner had officially recommended setting it aside as a Dominion Park in January 1915.[52] It took considerable pressure from public opinion in favour of making it a reserve before this was finally achieved. Taverner, as a civil servant,

was in a position to influence the Conservation Commission and other civil servants, but he had to be careful what he said and wrote in public. Also his speech impediment prevented him from talking in public. Meanwhile the Essex County Wild Life Conservation Association, which Miner and other sportsmen in the Point Pelee area had founded some years previously, was active in prodding government into action. After holding public meetings and writing letters to the appropriate authorities, the Association could rightly claim that its members had persuaded sportsmen of Essex county and the local press into supporting the idea of Point Pelee as a Dominion Park and therefore a bird reserve.[53]

By the beginning of 1918 Hewitt and Taverner were in correspondence, and early in May Hewitt invited Taverner to attend a meeting of the Advisory Board on Wildlife Protection in his office. The reason, Hewitt explained, was that a proposal to turn Point Pelee into a wildlife sanctuary was to be considered shortly and that, since Taverner was well acquainted with the conditions there, the Board would be glad if he could attend the meeting to give it his experience.[54] Point Pelee was proclaimed a National Park by the Governor-General the Duke of Devonshire on 29 May 1918. From this time onwards there was a regular and friendly correspondence between Taverner and Hewitt. For example, Hewitt asked Taverner to lend him some slides on Bonaventure Island for a lecture he was to give in Quebec, and thanked him warmly for the loan. In December 1918 Hewitt asked Taverner to prepare a short statement for the Advisory Board on the importance of Bonaventure Island and the Bird Rocks in the Gulf of St. Lawrence as bird sanctuaries, especially for the preservation of gannets. Hewitt explained:

> "I feel that you may speak with greater authority than I on account of your personal acquaintance with the islands".[55]

During 1919 they were in touch over such subjects as the preparation of a French checklist of Canadian birds, and the need for officially established bird names for a French translation of the Migratory Birds Convention Act. In another letter Hewitt thanked Taverner for detailed notes and suggestions that he had given for a chapter on game birds and larger non-game birds for inclusion in Hewitt's report on Wildlife Conservation. Taverner's notes covered: distribution, extent to which more or less common, and comments on protection.[56] Their correspondence ended in February 1920 with the sudden and unexpected death of Gordon Hewitt.[57] His book *The Conservation of the Wild Life of Canada* was published posthumously and probably contained some of the information which Taverner gave him on request.

When Point Pelee was set aside as a National Park the practice of fall duck hunting was allowed to continue on the Pelee marshes in spite of their being inside a game sanctuary. This caused an outcry among conservation supporters, outstanding among whom was W. E. Saunders.[58] His publicity against continued fall hunting drew a nasty letter from Edward R. Kerr, the Association's secretary, who wrote that he had been keeping a close eye on the situation at Point Pelee and noted that Saunders was particularly interested in a man named Bert Girardin who had been charged before F. H. Conover, the newly appointed park superintendent, with setting traps for muskrats and Mallard ducks.

> "On this occasion I presume he was only collecting specimens for your good self, at whose authority I am at a loss to know. If you enjoy special privileges on this Park it seems to me that you would not be within your rights in employing others to kill and collect specimens of birds or animal life. The question of taking of specimens of any kind on Dominion Parks and Bird Sanctuaries will be taken up by me with the government as it is a most unusual thing to permit and should be stopped at once."

This was the opening paragraph of an attack and was a sharp blast below the belt. Kerr followed this up with a second barrel of the same shot.

> "I note particularly that you are greatly enthused over and interested in the salvation of wild ducks visiting the marshes adjoining this landmark periodically and that it is your purpose to propose to the government that duck shooting be prohibited. So far as I am personally concerned it would make little difference to me but I have to bear in mind that upwards of one hundred and fifty good citizens of Ontario enjoy recreation with a gun and I prefer that they be permitted to take a fair toll of migratory water-fowl during a limited and favorable period of the year in preference to expending Canadian money to culture water-fowl to feed the stomachs of negroes and other gunners of the southern United States, Mexico and Central America. To shut off duck-shooting as an experiment would be silly. We need no experiment; we are not without experience as we have maintained in Ontario for thirty years a closed season during the spring of the year and water-fowl have decreased enormously and continuously. Of course you are entitled to your opinions and are at liberty to make any recommendations you deem advisable but I need not familiarize you with the fact that your views will be strenuously opposed. Personally I honor and respect you as an ornithologist but I cannot under any circumstance honor and respect the attitude you assume respecting what the people of Essex County alone have a right to discuss. I have already placed my views before the government.[59]

How Saunders answered this letter is not known, but he obviously did because a week later Kerr wrote another letter to him. This was about government permitting sportsmen to continue to shoot duck on the marshes when Point Pelee was set aside as a Dominion Park and Bird Sanctuary. He said that since 1911 the Essex County Wildlife Association had succeeded in keeping a closed season on quail with the result that the quail population was on the way to recovery. During the past seven years the Association had built up a friendly public feeling on

behalf of the Advisory Board on Wild Life Protection of which Dr. Hewitt was Secretary. Kerr then explained why members of the Association were allowed to shoot duck in the fall.

"At the time Point Pelee was set aside the question of inclusion of the marshes within the boundaries of the Sanctuary was discussed and the Honourable F. G. Macdiarmid, a universally recognized friend of the sportsmen, thought it unwise to deprive the sportsmen of limited duck-shooting and other recreation on the marshes. This matter hung fire until the association consented to the inclusion of the marshes with permission to take a small toll between October lst and December 15th, four days per week. There was no further discussion and the suggestion was adopted."

Kerr ended his letter by telling Saunders:

"I think you should have taken up with us the question of duck-shooting previous to recommending to Mr. Conover that it be abolished as no doubt the members would have liked to express themselves previous to any change."[60]

Although national parks are usually regarded as wildlife sanctuaries, in the case of Point Pelee in 1918, by special privilege, a fall duck hunt was permitted, and no government since has ever seen fit to stop it until 1989.[61]

Taverner was lucky to be able to leave the trouble over Point Pelee to others. However, he was still active over the future of Percé and Bonaventure islands. In 1918 he completed an important study of "The Gannets of Bonaventure" which appeared in *The Ottawa Naturalist*, and as a result offprints were available for wider distribution. It was written in a clear style which brought alive the scenes on Bonaventure Island described by Taverner in his letters written during his visits there in 1914 and 1915. It was also a strong plea for the protection of those powerful and fine-looking birds, the gannets, which summarized accurately their main aspects. Although from a political point of view all was ready for establishing bird sanctuaries there and on Percé in 1917, yet by May 1918 there were still problems in securing titles to land on the island as Taverner explained:

"There is a movement under way by the Conservation Commission to reserve this wonderful spot as a perpetual bird reserve under the control of Dominion or Provincial authorities, but such is the conservativeness, to call it by its mildest name, of the local population that considerable objections have had to be overcome and it is still doubtful after three years of effort, whether the plan will succeed or not. Some day the local population will realize that these rookeries are a source of attraction to strangers and too valuable a local asset to be wantonly destroyed. Until some such light breaks upon the community, and awakens public opinion and a spirit of protection, the senseless destruction will proceed. It is to be hoped either that the protective measures will be completed or this awaking will come before it is too late."[62]

Taverner also sent Hewitt a report on the urgent need to reserve Bonaventure. He stressed that the Gaspé region was becoming a tourist attraction, and that more revenue could be expected from it once it became a national reserve.[63] In November 1918 Harkin recommended that Bonaventure cliffs and Percé Rock be declared sanctuaries under the Migratory Birds Convention Act. In March 1919 the Quebec legislature passed a bill designating these areas as provincial bird sanctuaries, and a few days later they were declared federal bird sanctuaries by the Dominion Government.

Taverner had recently become active on the editorial committee of the Ottawa Field Naturalists' Club's journal *The Ottawa Naturalist*. It had meant a lot of hard work, and some lobbying before the policy of the journal could be changed, and the journal issued under a new title with a wider appeal. (For the part played by Taverner in bringing about this improved journal, appealing to a wider readership, see Chapter 10.) He used his position on the editorial committee to publish articles, notes and letters about the urgent need for wildlife protection. Taverner soon enlisted Hoyes Lloyd as an author and provided him with a useful platform for putting over information on bird protection in notes on topics such as "Bird Protection and the Law" and "The Ornithological Collector and the Law".[64] In return Lloyd enlisted Taverner to write on "Vanished and Vanishing Birds" in order to sound an alarm to anyone not yet aware of the extreme urgency of the situation.[65] In a small pamphlet Taverner gave examples of birds formerly known but by 1918 extinct – Passenger Pigeon, Great Auk (formerly on rocky islands in the Atlantic), Labrador Duck and the Eskimo Curlew which, Taverner wrote, was once so numerous that they were supplied to markets by the barrelfull but which by 1918 was in all probability extinct. "These are cases where the harm is already done. No regret, skilful law framing, or law enforcement will ever bring them back … "[66] To the present day reader Taverner's remarks on the extreme scarcity of several other birds in 1918 may come as a surprise. The Hudsonian Godwit was once so common that considerable bags [kills] could be made but now, Taverner said, it was so rare that scientific collectors were searching for stuffed specimens from old collections and out of the way places, while occurrences of living birds were important enough to warrant recording. Likewise the Wood Duck was progressing towards extinction. Only a generation ago, he wrote "it bred on nearly every slack water and overflow of our woodland streams and was the commonest summer duck within its range". But because it did not retreat to marshes where it would be comparatively safe during the breeding season it was easy game for the amateur sportsman. In the early fall, when the shooting season started, it was numerous on "ducking grounds" but its less wary habits made it an easier target. "Unless care is taken, this, the loveliest … of all our American ducks, will go the way of the Passenger Pigeon and the Eskimo

Curlew." The [Common] Eider had also been seriously reduced within living memory. The cause, he explained, was because it nested in great numbers on the north shore of the Gulf of St. Lawrence and in the Labrador, where dogs had cleared them from the mainland within reach of even the smallest settlement, while on the small adjoining islands they were easy prey to the fishermen. A comparison between the conditions reported by Audubon when he visited the area, and the situation in 1918 showed the grave effects of such wasteful usage. At that rate of decrease, Taverner estimated, it would be only a few decades before eiders would no longer breed on the coast. In addition, he said, nearly all species of game birds had been sadly reduced. The vast flights of waders, the pursuit of which once provided a recognized form of sport, were now so reduced as to hardly repay the effort of hunting. The same could be said of duck populations.

Taverner then turned to the causes of this steep decline in numbers which he blamed mainly on hunting. In recent years most jurisdictions within the provinces and states of America had made their own open seasons. These were short enough for each locality if the birds had to face no other, but as the birds worked their way south in the fall they moved from one local jurisdiction to another with the result that they were in a continuous open season. With the Migratory Birds Convention Act, Taverner explained, federal governments of Canada and the United States could control fall shooting both as regards length of season and numbers of birds allowed to be taken. When the birds returned in the spring, however, they had passed through this process of elimination, and those that survived were the stock on which the summer breeding of each species would depend. Spring shooting, Taverner said, was like killing cattle that have survived the winter and are about to increase, a policy no stockman would follow, and which should be equally avoided by the sportsman. If shooters in the United States could be persuaded to restrain themselves, we in Canada would have no excuse for not fulfilling our part part of the agreement. He ended his pamphlet with a strong endorsement:

> "It is to be hoped that all parts of the Dominion will uphold the authorities in their enforcement of the new game acts. If some are too shortsighted or selfish to deny themselves a little for the general good, it is well to remind them that the laws are now based upon treaty and as such form part of an international obligation which we, at least, do not intend to treat as a scrap of paper and will enforce regardless of the consequences to individuals."[67]

In his search for contributions to the upgraded *The Ottawa Naturalist* Taverner wrote to Miner asking him whether he would write a description and history of his experience banding geese. The magazine, Taverner wrote, was devoted to educational and scientific Natural History, and efforts were being made to appeal to nature students and protectionists. He suggested an article of about 1500 words, with one or two photos.[68] Miner replied on notepaper with the printed heading "John T. Miner & Sons Farmers and Drain Tile Manufacturers", excusing himself from writing the article. He said that he was trying to figure out how to make his hobby self-sustaining. He was undoubtedly protecting five times as many birds as any gov[ernment] game warden, yet he and his friends had been asking the gov[ernment] for financial help ever since 1910. Last year gov[ernment] gave him $100.- when in fact it cost him over $500.- for feed during March and April. Now he was planning to write a book on the value, migration and intelligence of our birds. He thought that he could sell copies of the book at the end of his lectures. So he hoped Taverner would pardon him for the present, and if Taverner would come to see his geese he would explain things more fully to him.[69]

Taverner replied with an encouraging letter suggesting that it might be possible to have Miner's place made into some type of national park under the Parks Branch. He argued that the Parks people fed the bison, elk and deer in their parks and would be able to feed winged game under similar circumstances. It might be worth considering. Taverner tried again to get Miner to write about the operation of his geese banding ponds. He suggested that a preliminary article in *The Ottawa Naturalist* would act as an advertisement for him, and would assist rather than hinder the publication of a book. He then told Miner of his belief that the conservation movement must reach the children.

> "The longer I engage in this work the more I am convinced that all such movements must begin with the children. It is almost impossible to teach old dogs new tricks but children are easily influenced and early impressions stick. The children of today are the grown people of ten years hence. The anti liquor movement was regarded as unheard of and absurd to the first generation. To the next it may have seemed uncalled for but it was not new. The following one thought there was considerable to say for it and the final generation accepted it. Thus it goes in all movements and none gain great headway except as the juveniles mature."[70]

But Taverner had no success; there is no article from Miner in *The Ottawa Naturalist*, nor later in *The Canadian Field-Naturalist*. However, he did have ample opportunity to talk with Miner about his wild geese sanctuary when Miner came to Ottawa to attend a National Conference on Game and Wildlife Conservation held in Ottawa on 18 and 19 February 1919. The Taverners had him to stay at their home.

This conference on wildlife conservation was co-hosted by the Advisory Board on Wild Life Protection and the Commission of Conservation. The object was to give members of the federal government a chance to meet provincial delegates, and for provincial game guardians and conservationists to

meet each other and discuss the regulations established under the Migratory Birds Convention Act, and a number of other wildlife issues. Gordon Hewitt, who led most of the important debates, gave the opening address in which he identified three major points: the need for *foresight* in wildlife preservation, the need for a *national effort* in wildlife preservation, and the need for close *dominion-provincial co-operation*. Hewitt's address set just the right tone to inspire the delegates with an understanding of the significance of what had been achieved already. He then spoke of the need for a nation-wide effort of all those concerned with protecting wildlife to assist provincial governments' law enforcement. "We shall never again have such an excellent opportunity", he concluded, "of attaining, by mutual efforts, the ends for which we are individually striving, as we have now".[71]

Various papers were given at the conference on various aspects of wildlife preservation, and discussed at some length. The idea of sanctuaries interested many delegates, perhaps because this was something very practical that showed direct results, and was something that citizens could take some part in. Edith Marsh related how the owners of Peasemarsh Farm in Georgian Bay managed to persuade the Ontario Government to declare their 300 acres of land as a wildlife preserve in 1917,[72] the same year in which the Ontario Government had declared the Miner family farm a provincial game reserve. Jack Miner then related his experiences in attracting wildfowl to his sanctuary.[73]

Although Percy Taverner did not give a talk he certainly attended the conference where he could continue to develop a wider network of useful people. Taverner had already played an important part in the wildlife protection movement through his bird researches at Pelee and Bonaventure, his official proposal for making both places National Parks, the information that he gave Gordon Hewitt, and his paper on Vanished and Vanishing Birds. Through Taverner we catch a glimpse of the conference in action. Writing to Swales he said:

> "We have just had a most profitable convention here of the game wardens and conservationists of the Dominion discussing the Migratory Bird Treaty. Nelson was here representing the U.S. All is not going absolutely smoothly here as Provincial rights are quite similar to state rights and we have a few dissenting provinces. Naturally we do not want to coerce until diplomacy has failed.... That historic 'scrap of paper' phrase comes in handy now and gives us a catch word that no one can dare question. It is the final argument when all else fails."[74]

Elsewhere in the same letter he reported:

> "Jack Miner was here to the protection meeting and lectured on his geese. He certainly is a genius. Though his grammar is a minus quantity his religious interpolations boresome and his humor unsophisticated his enthusiasm, sincerity and lack of self consciousness are such that his audience go crazy over him and every one that hears him loves him and takes his lesson to heart. He had the crowd actually weeping between bursts of side splitting laughter. He is certainly a wonder and can do more for protection than any other agency I know of. He leaves a trail of enthusiasm behind."[75]

Writing to Fleming on the same subject he said:

> "They had Jack Miner here to speak before the conference on his geese. He certainly made a hit. Had to repeat his lecture in the Normal School and the house was packed and about ten times as enthusiastic as with Hornaday who spoke the night before. They are considering sending him on a grand tour lecturing all over Canada. He can do more for the subject of protection, and the Convention, than any other influence I know."[76]

After the conference Miner wrote a "thank you" letter to Taverner from Union Station, Toronto, on his way home, as follows:

> "My dear Percee
> Many, many thanks for a rite good time. Please thank mother for me. I was well pleased to think I stopped over. Will you send me paper containing report (should there be one). Should I get any more owls in good health I will send you one or two... So Long from Jack Miner"[77]

To which Taverner replied that he was sorry there was no notice of his lecture in the next day's paper but all the reporters were busy with Laurier's funeral. Taverner guessed they had covered Miner's talk in the paper of the previous day but added:

> "At any rate you caught the crowd in great shape. The next day everybody was talking of it and Ottawa was divided into two classes, those who were there and those who wished they had been."[78]

The reference to the owls "in good health" has a rather sad significance. By this time Miner had begun to defend the birds in his sanctuary from predators, mainly hawks and owls, by a programme of pole trapping. While he was visiting Ottawa, Taverner asked him if he would be willing to send the National Museum a few of the owls and hawks which were in reasonably good condition. They could be sent C.O.D. Since the museum still needed specimens to complete its sets of skins Taverner was glad to have some, however much he disliked the idea of owls and hawks hanging from a pole with one leg almost severed. Miner had no such feelings. He claimed that it was the will of God that any bird or mammal that killed song or game birds should be exterminated. God's will conveniently supported Jack Miner's will. Many naturalists were disgusted by the callous pain inflicted on owls and hawks by Miner through the use of pole traps. This became a hot issue that smouldered throughout the 1920s and 1930s, and involved Taverner in his position as Dominion Ornithologist.[79]

Taverner's contribution to the struggle for wildlife conservation in the years covered by this chapter had important results for birds on Point Pelee, on Percé, and Bonaventure Islands.[80] This alone was an outstanding achievement, but in addition he influenced the awareness of the general public about birds and

the need for protecting them and conserving their habitats. This he did by his numerous articles, and by his films, photographs and slides. His greatest influence on the public at this time was through his first book, *Birds of Eastern Canada*. This is the subject of the next chapter.

One further achievement should be mentioned. His warm co-operation with Charles Townsend led to Townsend's survey of the summer birds of the Gaspé Peninsula which had not previously been studied. In his article Townsend acknowledged the use he made of Taverner's notes kept during the summers of 1914 and 1915, and praised the part played by Taverner in determining the Provincial government to make Percé, Bonaventure, and Bird Rock near the Magdalen Islands into reservations. Townsend saw this as a good precedent and he hoped that other reservations would be added elsewhere, especially along the Labrador coast where they were much needed.[81]

## CHAPTER 10. Birds of Eastern Canada

> "I hope one of these days we may be able to issue a Canadian book with illustrations by you and make it wholly Canadian as well as wholly good".
>
> P. A. Taverner in a letter to A. Brooks[1]

This chapter is about two of Taverner's concerns in the period 1912 through 1919. A major concern was to write and publish a book on all the birds normally found in Canada. Another was how to turn *The Ottawa Naturalist*, a modest, local naturalist periodical, into a more substantial one with Dominion-wide appeal.

Taverner had been at the National Museum for less than a year when he began to consider the need for a reliable guide to the birds of Canada to replace the *Catalogue of Canadian Birds* by John and James Macoun. He knew very well how frustrating it was to be a keen ornithologist yet lack a field guide that was scientifically reliable, and illustrated in colour. What, then, were the books that existed in 1912 for naturalists in Canada who were seriously interested in the study of birds? If Taverner had been asked this question he would have mentioned the following: John and James M. Macoun *Catalogue of Canadian* Birds revised edition (Ottawa 1909).[2] Ernest E. Thompson [Seton] "The Birds of Manitoba" *Proceedings of the United States National Museum* 13 (Washington 1891) pages 457-643. Thomas McIlwraith *The Birds of Ontario* 2nd edition (Toronto 1894). C. E. Dionne *Les Oiseaux de la Province de Québec* (Québec 1906).

In a wider context Taverner would have referred the enquirer to Elliot Coues *Key to the Birds of North America* of which he wrote:

> "This is perhaps the most generally accepted authority upon American birds. It is primarily intended for the advanced student but it contains a mass of information that can be found nowhere else and is a final court of appeal to the majority of ornithologists".[3]

Robert Ridgway *The Birds of North and Middle America* U.S. National Museum Bulletins (Washington 1901—). Seven volumes were then in print. Frank M. Chapman *Handbook of the Birds of Eastern North America* (New York 1895). First revised edition 1911. Chester Reed *Birds of Eastern North America* Part I Water and Game Birds east of the Rockies; Part II Land Birds east of the Rockies (1905-1906). The two parts were combined into a single volume (New York 1912). A coloured illustration accompanied each species described. These were printed from watercoloured paintings made directly from "perfectly plumaged specimens" which, the author claimed, "faithfully represents each species in a pose commonly assumed in life". Reed's illustrated pocket guide was a step forward in the design of bird guides, and probably influenced subsequent writers of guides.

SANDPIPERS

**(242) Pisobia minutilia** (*Vieill.*) (Lat., very small).
LEAST SANDPIPER; PEEP. Feathers of upper parts edged with bright rusty; breast distinctly streaked with dusky. L., 6.00; W., 3.50; Tar., .70; B., .75.
*Range* — Breeds from N. S. and Keewatin northward. Winters from southern U. S. southward.

**(246) Ereunêtes pusillus** (*Linn.*) (Gr., a searcher; Lat., small).
SEMIPALMATED SANDPIPER; PEEP. Slightly grayer than the last; breast indistinctly streaked. Feet with partial webs.
*Range* — Same as preceding.

**(247) E. maûri** Cabanis
WESTERN SANDPIPER. Bill averaging a trifle longer; Chiefly west of the Rockies.


that of the Pectoral and Least Sandpipers. The former is the more abundant during migrations on the Atlantic coast, while the latter is much more common in the interior.
Their habits are not different in any way from the more common smaller sandpipers with which they are often associated. The difference in size is quite evident when they are seen together.
"Peeps," by which name both LEAST and SEMIPALMATED SANDPIPERS are most often called, are by far the most abundant as well as the smallest species of sandpipers that we have. Although of different genera, they may well be considered together, for their habits are the same, and in life they are usually associated during nesting, migrations, and in their winter quarters.
As we usually see them, the upper parts of the Little Stint are quite rusty, while the back of the Semipalmated species is inclined to grayish. The breast of the former is distinctly streaked, while that of the latter is very indistinctly so.

Selection from Chester Reed's *Bird Guide* (1912) vest-pocket edition.

It was clear to Taverner that the kind of book he wanted had not yet been written. As there was no precedent for the style and organization of the book he visualized it was clear that he would have to take the first step himself. This happened in 1912 when he realized that writing an illustrated guide to the birds of Canada was beyond the scope of one man. What he needed was the cooperation of someone who knew the birds of western Canada. He also needed a good bird illustrator. In his conversations with Fleming, and in their correspondence, he had often heard of Allan Brooks as a first-rate Canadian ornithologist who was also an accomplished wildlife artist. It seemed to Taverner that Brooks might be the man he was looking for, and in March 1912 Taverner wrote to him introducing himself and mentioning their mutual friend Fleming.[4] Brooks replied that he hoped to meet Taverner in Ottawa in August while "at the rifle matches".[5] Taverner followed with a letter outlining his needs which were for information on, and specimens of, the fauna of Canada. He also wanted to get all the information he could get from "good men" for a new edition of the Macouns' *Catalogue of Canadian Birds*. The problem would be that of judging the merits of the contributors. He would want to know them personally, or to have them vouched for by reliable people. He hoped to have Brooks' help in much of this work, and to talk with him about such matters in Ottawa. He confided that he had a larger ambition. "I hope one of these days we may be able to issue a Canadian book with illustrations by you and make it wholly Canadian as well as wholly good".[6] Brooks and Taverner met briefly in Ottawa late in August.[7] During the winter of 1912 they corresponded a few times, mainly about the possibility of collaborating on a book.[8]

In 1913 the two men met again in Ottawa where Brooks was taking part in rifle matches, and they spent a day together partly at the Taverners' home and partly in the museum. In a letter to Fleming Taverner said he was surprised how expertly Brooks picked out the subspecies in a tray of birds. "He went over the Hermit Thrushes as fast as he could finger them and named them as he went, and his determinations tallied in every case with Oberholser's".[9] Taverner was pleased to have started a friendship with an experienced Canadian ornithologist whose opinions on determinations he could trust. The fact that Brooks was becoming recognized in North America as an outstanding illustrator of birds was an additional advantage. The artist's eye for colours and details of plumage was of special importance in making correct determinations, and in painting lifelike birds.

After Brooks left Ottawa Taverner wrote two letters about the proposed book. To Fleming he wrote saying that a new Canadian bird book would have to be written in the near future. He realized the problem posed by the lack of specimens and data but, nevertheless, "... more is available now than ever was before and the time will never come when we can say that we know everything for such a work... I have been thinking deeply over the question and will think more." Taverner asked if Fleming felt it would be necessary to write new descriptions since these had been written over and over again. Why not, he asked, copy descriptions already in use, where they were adequate, although more plumages of juvenile birds ought to be described. He was planning, he said, to start work in the fall of 1913, when in New York, by looking at the Canadian specimens in the collections of Dwight, and in the American Museum, and then in New Haven, working through Bishop's collection. Later he would need to visit the collections in Boston, and the US Biological Survey's collection in Washington. The following summer he hoped to look through collections in eastern Canada. He then put forward several ideas for the format and organization of the book which he repeated in a letter to Brooks on the same day.[10]

Taverner started by telling Brooks that the subject of publishing a Canadian bird book had come up much sooner than he had expected. The English edition of the Macouns' catalogue was now out of print, and since many people had written to the museum for a copy the authorities had consulted him on how to satisfy this demand. Taverner cautioned against reprinting the old list or rewriting it because the Macouns' list was not what most applicants wanted. Taverner then set down what he considered should be done. What he wanted was a book on the birds of Canada giving a key and descriptions of each species together with information on its distribution and, where appropriate, its behaviour. The distribution of species should be indicated by a small map opposite each one. He told Brooks that ideally he would like to have one illustration to each species. The book should aim to be popular in interest and scientific in accuracy. Such a book would be expensive to publish because the demand for it would be considerable and a large edition would be essential. Since no one man could do justice to such a large undertaking, Taverner proposed that it should be published under the joint authorship of Brooks, Fleming and himself.

> "If Saunders would come in on it well and good, he can bring an immense amount of life history information into the project but I doubt whether he will come".

He proposed that each author should write the sections that he was best informed about and receive credit from his initials at the end of the paragraph, or whatever he had written. It would take a great deal of preparation because a great deal of work would have to be done looking through several American and all Canadian collections. Taverner estimated the preparation would take two or three years. He ended the letter by asking Brooks to consider the idea and let him have his suggestions.

> "Also what terms you would require for picture work".[11]

A fortnight later, in a letter to Fleming, Taverner refined what he had recently written to Brooks. He said that although the Macoun book had a wide circulation it was only of use to the advanced student of birds who wanted detailed information on their distribution. Taverner guessed that there was not more than a dozen men in the Dominion who could use the book to advantage since it did not contain descriptions, nor information on behaviour. What was needed, he said, was a reference book to fill the long-standing need of the less advanced bird student in Canada. This would be a large undertaking that would require the help of men experienced in ornithological study in Canada. The first problem, he pointed out, would be to devise a plan of work that would satisfy all contributors. He suggested that wherever possible a brief note on "field marks" should be included. Each species should be the focus of the information while subspecies should simply be mentioned by name. Taverner suggested a scheme of how the text could be written so that each contributor received full credit for his work. He added a modest word about himself when he wrote:

> "I am afraid that I could bring least to the common fund though naturally I would like to be in on it. I wonder how some such scheme as this would work out. THE BIRDS OF CANADA, by J. H. Fleming, Allan Brooks and W. E. Saunders (if the latter would come in) edited by P. A. Taverner. Illustrations by Allan Brooks".

Finally he asked Fleming what he thought of the scheme, and added

> "if Saunders cares to come in well and good, if not I guess we can get along without him and it will be his loss." [12]

Taverner knew Fleming and Saunders well from experiences shared with them in the Great Lakes Ornithological Club. He knew how cautious Fleming was about committing himself to print. Saunders was the opposite. He spread himself widely over the field of natural history producing a large number of articles and notes on birds, plants, insects and horticulture. This would have been enough to inhibit him from starting any major work. Taverner wisely cast himself in the role of editor. In this way he could ensure that the contributions of others would be used to produce the kind of book he felt was wanted by the kind of public he visualized. From Taverner's viewpoint in 1913 Fleming and Saunders were his mentors in ornithology while he was their protege at the museum. He now offered them the opportunity, together with Brooks, to be the authors of this, the first handbook to be devoted to Canadian birds.

Fleming's answer was typically cautious. He took care to point out all the problems. His letter told a lot about Fleming and his attitude to anything ornithological. By contrast Taverner may have appeared a little too ready to tackle problems head on, and push forward with the job. The question of writing a "birds of Canada" was a serious one, Fleming said, because in Canada we did not have a working series of skins, we knew insufficient of where skins were distributed, and we had yet to find out what specimens there were in American collections. He then stated his own position as regards collaborating with Taverner.

> "Personally I think you are competent to do the work except the question of subspecies which I don't think you are interested in which is where Brooks and myself would come in. Life histories I could not manage at any price. I could do the descriptions but it is a weary task and I would require a good stenographer as well as the material to work on. I do not know if I am justified in imposing such an amount of work on myself".

However, he said, he would be glad to help whoever wrote it.[13] Brooks was more practical in his reply. He said he would do his best to help in any way, and would be willing to come to Ottawa for six months. He suggested painting four species to a plate, without backgrounds, like Fuertes' illustrations in *Bird Lore*. The price would be about $25.00 per plate.[14]

During 1914 much of Taverner's time was taken up with the expedition to Miscou Island and the Gaspé Peninsula, as well as with writing up the results. Museum administration took up the rest of his time and the book was pushed aside. Brooks went to England in June 1914 with the Canadian Rifle Team and was competing at Bisley when on August 4th the war broke out. Since Brooks already had an officer's commission in the Canadian Militia he returned to Canada to the training camp of the First Canadian Contingent at Valcartier, Quebec.[15] Taverner was able to talk with him before he sailed for England and the First World War. Brooks was to be away from Canada for the next four and a half years. With Brooks involved abroad and a very uncertain future Taverner now turned to young Frank Hennessey to produce coloured illustrations to accompany each species in the projected book.

Although there is no indication in his correspondence at this time of Taverner's disappointment at the loss of Brooks' collaboration on the book, nevertheless he must have felt considerable frustration.[16] Apart from Louis Fuertes, the outstanding bird portraitist of his time, Brooks had begun to make his mark in North America. Although Taverner was glad to be able to get Hennessey to paint the illustrations, he openly admitted that they were inferior. Anyone comparing Brooks' bird portraits with those by Hennessey will understand how Taverner must have felt. He suffered an unlucky stroke of fate just when the prelims. of the plates for his book were needed.[17]

Early in 1915 Taverner began work on an outline for the book. In April he sent Fleming a draft "prospectus" asking for his suggestions. Using the genus *Sterna* as an example this is what he proposed to include in the book: A total of one hundred species should be included of which so far eighty-

three had been chosen. He asked for advice on the remaining seventeen species to be selected. He considered including a key to the orders based on line drawings of bills and feet. With the prospectus he sent some illustrations to give an idea of their size and general effect. He hoped to be able to persuade the Government printers to produce a very much better quality in printing the illustrations than the Government normally managed. On matters of printing and illustrating Taverner wrote with some authority due to his training as a draftsman and his experience as a bird illustrator.[18] Fleming replied that Taverner's plan for the "bird prospectus" was excellent. He sent a list of suggestions for Taverner to consider. One was about the type of language to be used. Fleming considered this the key to success, and told Taverner to bear in mind the importance of simple language when writing. "Why not consult a country schoolteacher on this point", he wrote. He also included a list of about thirty birds that he suggested might be included. Under [American] Black Duck he noted that it was much commoner than the Mallard — it was more distinctly an eastern duck. Another suggestion he made was to include coloured plates of birds' eggs. Since so many boys collected eggs, he explained, why not guide them by indicating proper rules for collectors.[19]

Taverner first answered Fleming's points, then restated his main aim, which was to provide a fairly complete coverage of the birds of eastern Canada, of all those that observers would be likely to see. He would prefer not to describe fall and intermediate plumages because the book was designed for an elementary level of knowledge. The inclusion of detailed plumage descriptions would be more likely to discourage, rather than encourage, readers. The novice, he wrote, should learn to identify the adults in spring plumage first; other plumages would be recognized more easily later.[20]

In a letter to his friend Swales he said that he had just started an interesting job, a popular "Birds of Eastern Canada", for which there was a definite demand. "The people want it and it will do more to awaken public interest in our Department than anything else. Popular interest is what the government scientific departments need in their business". If the authorities would let him produce it in the way he wanted, he said, it would be "some book", with 100 coloured illustrations and a key. He had it planned out, and a dummy made which Fleming had approved, and he was now waiting for suggestions from Saunders.[21]

Taverner was in the Gaspé and the Gulf of the St. Lawrence during June and July 1915 and when he returned was busy with museum matters. However, he was in touch with Fleming about Hennessey's illustrations, and sent him copies of the first two reproductions made by the printer who would be responsible for the coloured illustrations. Taverner considered them to be quite satisfactory.[22] Fleming replied that Hennessey's drawing of the Bobwhite was far ahead of the Blackburnian Warbler which he considered weak. He wanted Percy to come to Toronto during the time of the Canadian National Exhibition when railway rates would be cheaper. Fleming was quite insistent. "Better come up to get my help in identifying specimens and advice on the colour and makeup of your new bird book. There is much to talk about and to see".[23] Taverner was well aware of Hennessey's immaturity as a bird artist and wrote to Fleming that he was impressing on Hennessey the need for accuracy in drawing bills which was his main weakness at present, though his portrayal of the eyes also needed watching. But Taverner recognized the progress Hennessey had made since he was first hired on a temporary basis by the museum in 1913. As he expressed it to Fleming "one cannot expect a Fuertes or Brooks all at once. This large order, with me at his elbow, I think will be of great benefit to him".[24] By mid-September, when Hennessey had to return to college to continue his education, he had completed about 60 of the illustrations and Taverner was hopeful that he would be able to finish the rest before Christmas.[25]

Meanwhile Taverner was in touch with Saunders about the bird book, sending him a prospectus, and asking for his opinion.[26] Saunders replied making a number of suggestions, and Taverner answered them. He added: "I will be very glad of your assistance and accept your offer thankfully. We want to make this as good as it is possible to make and your advice will be invaluable".[27] In October 1915 Taverner managed to meet Saunders in London and see Fleming in Toronto in order to discuss ideas about the book. He then started writing the text, species by species.

For Taverner 1916 was the year of the book. He neglected everything that he could in order to keep writing. By early 1916 he had reached the shorebirds. He wrote to Fleming asking if he would be kind enough to read sections, as he wrote them, in order to catch any mistakes. To prepare Fleming for an expanded text he wrote: "It has much outgrown the first intention. But as we are getting the expensive pictures I feel that a little extra work in writing and letterpress is excusable".[28] Fleming replied: "I shall be glad to do all I can to help you on the bird book so send it along".[29]

Taverner decided to remain in Ottawa during the field season of 1916 in order to devote most of his time to the book. This decision became an obvious one when the Parliament building caught fire in February 1916, and Parliament moved into the National Museum. As a result the exhibition halls were no longer open to the public, and consequently Taverner had less work to distract him from writing. He now worked continuously on the first draft of the book, sending chapters to Fleming and Saunders, at

intervals, for their comments. In February he sent Fleming three sections to read. He said this was his second set of corrections, and he felt the text was not far from the final form. He had three main ideas in writing the book, he wrote. The first was to describe each species so that the common man could recognize it; the second was to note its economic value; the third to arouse a feeling for the protection of birds.[30] With the next section he enclosed a letter to Fleming in which he explained his plan for including subspecies. He proposed to describe only species while recognizing subspecies only "as occasion demands", and would explain the reason for this in an introduction.[31] He expected to be criticized by leading ornithologists for appearing to disregard the importance of subspecies. But he felt that it was necessary for him to make a stand at this time, when he was working on a guide book for the ordinary observer, especially since he expected that it would be used by a new wave of observers.[32]

By now progress was rapid as sections of the manuscript moved back and forth between Taverner and Fleming. In returning another section of text Fleming found only one fault. He suggested that Taverner should avoid using uncommon words such as "presage, palatable, unimpeachable and differentiation". Simpler words would be understood better.[33] Taverner sent a forceful reply. Certainly, he said, he wanted to avoid making the book above his readers' heads, but he did not want to turn it into a primer. It was not advisable to avoid using good English words that any high school student should know.

> "If they do not know them",

he wrote,

> "there is something wrong with their educational system. The words you mention are words of just this class. If readers do not know them it is time they did. I think modern educational systems are too much on the Kindergarten system any way. Children are too much written down to and are not encouraged to develop. I have been talking this over with Mr. Slemon, the director of the Nature Study work in the Public Schools and he agreed with me. He has however promised to go over the ms. when I get it in shape and criticise the wording from a school teacher's standpoint."[34]

When Fleming received the section of the book which included the herons and bitterns he was rather surprised to read that Taverner had included casual stragglers such as Glossy Ibis and American [Great] Egret in a book designed to introduce new observers to the field study of birds in eastern Canada. What Fleming particularly disapproved of was the wording of the entry under American Egret. Taverner had written a substantial paragraph on the effect of collecting birds' plumes for sale in the millinery trade. After briefly describing plumage, field marks, nesting, and distribution Taverner condemned the taking of egret plumes in terms that are surprisingly strong for a scientific bird guide. Fleming wrote advising him not to get involved with the Audubon "outfit" and to omit the egret matter from the book.[35] Fleming said he realized that Taverner would find some of his comments unpleasant, but he wrote from a genuine wish that Taverner do justice to himself. Nevertheless, he returned to the question of the kind of English he should use, and lectured him once again. In spite of saying that his duties would end when he had checked the correctness of the descriptions and ranges he then told Taverner that his use of English was deteriorating; it showed a "tendency to flacidness".[36]

This was an unpleasant letter to receive, even when it was from an old friend with the best of intentions. Taverner reacted with a long reply. He had no objection, he said, to the openness of Fleming's criticism. What he wanted was Fleming's sincere opinions even if he did not agree with him. Fleming need have no fear of hurting his feelings.

> "We do not view all things eye to eye and probably it is a good thing we do not. I think that criticism is good for us all even when we do not think it is quite justified".

As regards the Audubon people, Taverner said, he was in full sympathy with many of their objectives, or to put it the other way round they were in sympathy with many of his. What he objected to were their methods — their attitude towards scientific collection, their exaggeration, and their sentimental slop. Next he turned to the question of the economic value of birds. Their value, he said, has been greatly exaggerated. They are probably important as a controlling influence in the reduction of insect pests, but only as one of the influences. Probably parasites should come first with birds second or third. But they are important enough to make their economic value a practical reason for their protection. However, even if a large number of birds were to be killed not everything green would be eaten by the bugs. "The real reason for the protection of birds", he wrote, "is an esthetic one, the pleasure in having them around, and becoming acquainted with them either individually or specifically". He then returned to the trade in egrets. He had included the American Egret in the book because he felt so strongly on the matter. He wrote: "I think it is our duty to do this hence I lugged in bodily the egret in a Canadian bird book as the most striking example of the iniquity of the trade". Taverner ended his long letter by stating that his feelings were not hurt.[37]

By May 1916 Taverner was confident that the museum authorities would publish his book. It was now not a question of whether but of *how* they would print it. He took the matter seriously, and had three sets of different page specimens made in order to decide on type and the general layout. He sent a copy of each to Fleming asking for his opinion. The main question was where to place the illustrations. Taverner wanted each one to be with its own text and not several pages away from it. He also wanted it to be printed as a pocket handbook but could not get the museum authorities to agree. It was to be

issued in the museum bulletin format and they would not break the size of the set. However, Taverner, whose hobby was bookbinding, said he would try to have it printed with wide margins so that the bulletin format could be heavily trimmed to reduce it to pocket size.[38] The last two pages of the letter were full of bird information including the news that a Caspian Tern had been sent to him from Quebec. He commented "It is our only specimen and I am glad to get it".[39]

By now Allan Brooks had been in France for two years and had been in action several times. He was promoted Major in November 1915. Taverner wrote to him regularly and his long and newsy bird letters were much appreciated by Brooks. Meanwhile Taverner's sister, Ida, and his secretary, Miss Bentley, sent parcels to the major. In one letter to Taverner Brooks asked him to thank Miss Bentley for the knitted socks etc. In May 1916 Taverner wrote that Hennessey had just finished the last of the one hundred bird pictures for the book. Although some were not good, on the whole they were very satisfactory, and some were very good. Taverner then discussed the text, and some of the problems he met in writing it.[40] In May 1917 Brooks sent Taverner a long letter about birds. Taverner, writing to Fleming, reported that Brooks had been collecting birds just behind the battle line "and is sending some of his specimens over to us. You cannot keep a good man down".[41] The Brooks-Taverner correspondence during the four years that Brooks was in France (1915-1918) tells little about the war and much about ornithology. Although there were not many letters exchanged those that exist are very interesting in content. They take the form of ornithological discussions between two thoughtful Canadians. For instance in one letter Brooks wrote about the need for a limited use of subspecies because some had different calls from the species, while others had developed anatomical and structural differences. In another letter Brooks wrote on the problem of colour in painting bird plumages. Colours, he wrote, are so largely dependent on the light in which they are seen, and amount of wear on the feathers, that colour values are largely a question of comparison.[42] Several quotations from Brooks" letters, set in the context of when they were written, are given in H. M. Laing's biography of Brooks.[43]

The debate between Fleming and Taverner over whether to include subspecies went backwards and forwards through the mail like the volleying of two tenacious tennis players. When Fleming protested Taverner's idea of cutting out the three scientific names for each subspecies (trinomials) Taverner replied that he would explain the reason in the introduction. The public, he wrote, must have a common name by which they can speak of species without having to refer to particular subspecies. He continued

> "When the public realize that a subspecies is only a fine splitting of little popular interest and can be disregarded except in specially technical work I think a great point will have been gained. I expect to be criticised for this stand but I am sure that I am right."[44]

Not all was written in a rather harsh tone. Fleming admitted that he would not have made himself so objectionable had he not known that Taverner could improve on the draft he had read. Fleming admitted that no laymen, for whom it was written, would see the objections that he did, least of all the Conservation Commission. He then gave Taverner some lukewarm praise.

> "You deserve much credit for the work you have done. I never could have stuck it out myself and I only wish you had left innovations to some other time and place".[45]

Taverner did not accept this weakly, but hit back a few days later about there being room for argument in questions of policy and perhaps principles.

> "I think that a popular work such as this is just the medium to introduce a sane presentation of the subspecies question".

He said he aimed to get "the young Canadian observers started right" so that the importance of subspecies is kept in its proper proportion.

> "Let the splitter split all he has a mind to. That is his business as long as the other man knows that it is only subspecific and of but technical interest only ..."[46]

Taverner's mind was quite heated over the question of species and in October he returned to the issue in a letter to Brooks. He told him that the manuscript was now finished. It had taken a year's work and had been quite a load to carry. He was innovating by using a different nomenclature, one that was bound to arouse criticism. In each case the AOU check-list gave the specific name of the type subspecies in the vernacular nomenclature. This, Taverner claimed, was wrong. He continued:

> "The idea that the species is what is left after the subspecies has been split from it is incorrect. The original specific common name should remain covering all the races while the type subspecies should be regarded as but another form with no superiority of rank over the other subspecies. I have made the common names agree with this conception".[47]

The Taverner-Fleming cross-fire spluttered on through September and October, both sides repeating their arguments. In a long letter of early October Fleming made one more attempt to explain his point of view to Taverner, then ended his letter on a conciliatory note.

> "I suppose an exchange of ideas is good and I wish you luck in your controversy. I am glad we can disagree without rancour but I feel it is more a misunderstanding of what each other means".[48]

This is true. Reduced to its essence what Taverner argued was that the species is a definite unit of classification, each species being sharply separated from other species, while subspecies "merge into allied forms at each point of contact".[49] Fleming, however, maintained that a species is not a definite unit, it is a

group in which no one member is of higher rank than another.[50]

Although the manuscript of the book was in the hands of the editor, William McInnes, by October 1916, Taverner was still not free to give all his time to other matters that required his attention. Since the beginning of the year Taverner and McInnes had been in correspondence over the content and format of the book without coming to an agreement. McInnes was a geologist of long experience whose last field work had ended in 1910. He was then assigned to scientific editing and administrative work related to the International Geological Congress of 1913. He was the general editor of the report by the Congress on *Coal Resources of the World* in 3 volumes. He was appointed "Directing Geologist" of the Survey in 1915, and assumed the duty of editing the publications of the Survey such as the Bulletins and Memoirs.[51] McInnes had a clear idea of what was required in a publication of the Biological Survey — a plain statement of facts presented in a regular format with no allowance for any innovation, imagination or literary style. McInnes was not used to authors in the Survey having any ideas on the content and style of a book, and would not make any concessions. Taverner, however, had strong ideas of what he considered would best educate the public for whom he was writing. At times Taverner could be stubborn, especially when he was convinced that his ideas and methods were the best in a particular situation. This was such an occasion and he dug his heels in. Predictably McInnes disagreed and the verbal hassle continued throughout 1916 and into February 1917 when Taverner, writing to Townsend, mentioned that the book was still occupying a lot of valuable time, and explained why.

> "I cannot make the authorities above see eye to eye with me as to its style and general tone and it has been a continual struggle to save it from being reduced to [a] Reed pocket book guide without the convenience of the small size of that publication".

He explained that because it was more popular in character than most official publications it was important that the life should not be knocked out of it. "Government red tape", he added, "is tangled and slow to unravel".[52] Taverner had worked at the museum long enough by now to know the strangling effects of red tape, but to find it strangling his own creation into which he had put some original ideas was exasperating. He refused to give in and finally Taverner and McInnes referred their disagreement to McInnes' immediate superior, R.G. McConnell, Deputy Minister, Department of Mines. Taverner gave Fleming this information in February:

> "I hope I am coming out all right with the bird book. McInnes and I reached a stalemate and referred the matter to McConnell. He has advised with Macoun but is anyway more sympathetic than McInnes. I think that between Macoun and I we can keep the best part of the matter".[53]

Things were eventually straightened out but this delayed the book for a year because Taverner was ready to leave on his field expedition to the western provinces, postponed in 1916, and therefore could not remain in Ottawa to prepare the manuscript for the printer. The revised version finally went to the printer in August 1918. Page proofs came back in the spring of 1919 and Taverner finished correcting them by early June but was afraid that a good many "bulls" [mistakes] might have been missed. He explained to Fleming that this was because

> "the system of the editorial office follows the policy that it knows much more than the author and he needs be consulted only occasionally. The editor makes all determinations and it is only accident when the author is informed of decisions and usually too late to change it. Nice isn't it?"[54]

Taverner's ability to write scathing comments was, by now, well developed.

*Birds of Eastern Canada* was published early in November 1919, though dogged with troubles to the end. Writing to Brooks to tell him that a copy was on its way to him Taverner said that there had been a lot of trouble over its distribution and it was almost held up altogether, "but that is nothing for this book". According to Taverner: "It is only a mere shadow of its former or original text. Remember this when you are disposed to criticise it, you will have lots of opportunity".[55] Before the criticism rained down a letter arrived from Louis Agassiz Fuertes complimenting him on the book, and Hennessey on the illustrations, especially the bluebird and warblers.[56] It was a welcome letter, especially in view of what Taverner told Fuertes in his reply. He said that a government official was advised by "one of the greatest bird authorities on the continent" that the warbler illustrations were inaccurate in the markings on their plumages, and that the whole edition should be withdrawn.[57] The name of this great bird authority was never revealed. Taverner was cheered by a short note from Hewitt who said that such a study had been needed for a long time, and continued: "It will do an immense amount of good and I venture to predict that it will soon be out of print".[58]

Taverner himself was not entirely pleased with the result because he had not been allowed to follow out his own ideas fully. This was all the more frustrating for him because, with his experience as a draftsman, he knew more than most people about printing and binding, photography and types of paper. As an ornithologist not trained in any professional tradition he had a fresh approach which he wanted to carry out in his first book, but which could not be fully incorporated. Also he was not satisfied with the illustrations which he had hoped would have been painted by Allan Brooks. He knew that Hennessey's were not high grade, but he had to put a good face on the problem, and he accepted them as serviceable. There was no one else in Canada at that time, apart

from Brooks, who could produce coloured illustrations showing the distinctive markings of one hundred species. Taverner was reasonably satisfied with the brief descriptions of each species he had written, though he was less than satisfied with his short sentences on the distribution of each species. This, however, was not something that he could remedy because of insufficient information in Canada. He had incorporated as much information as he could from what local lists he had obtained from men such as W. H. Mousley and R. W. Tufts,[59] and from his own distribution maps based on the museum collection. Most of the information came from Taverner's own observations supplemented by those of Fleming and Saunders and correspondence with many people.

Contemporary opinions of the book by authoritative ornithologists were reasonably appreciative. The fullest review was by Witmer Stone in *The Auk*. The first half of this two-page review discussed the book from the point of view of the general reader, and began as follows:

> "This notable work has been prepared to meet a growing demand for a handbook that will present in concise form the more important information on the habits and distribution of the birds of East Canada and keys and descriptions that will enable one to identify them. In providing for all these needs we think that the author has been remarkably successful."

Stone also wrote appreciatively of the illustrations.

> "The colored plates by Mr. Frank C. Hennessey are very attractive and the postures of the birds usually good, some of them like the Kinglets rather daring in their originality. Mr. Hennessey evidently studies his birds and his paintings are his own interpretation of what he sees rather than copies of conventional attitudes. We need just such effort in ornithological illustration."

However, Stone was critical of Taverner's attempt to dispense with subspecies in the nomenclature which he called "an unfortunate feature of this work", because they caused some confusion in the mind of the reader. The systematic index also leads to misunderstandings when trying to carry out the author's nomenclature.[60] A one paragraph review of *Birds of Eastern Canada*, by Lynds Jones, appeared in *The Wilson Bulletin*. In his opinion Taverner's unconventional presentation of the material in the species list seemed worth studying in spite of the inconvenience it caused by not following the 1910 edition of the AOU Check-list. He also said that the coloured plates of F. C. Hennessey "shows that we have another successful artist in the field".[61] W. E. Saunders wrote a critical review of it in *The Canadian Field-Naturalist* but explained that the author had included more interesting detail in the first draft than appeared in the printed version. Saunders placed the blame for this on "a mistaken editorial policy". The reason for the elimination of so much, he said, could only have been through poor judgment or economy. This supports Taverner's statement in a letter to Brooks "it is only a mere shadow of its original text".

However, since this book was intended to be for general readers rather than advanced ornithologists its reception can best be judged by the size of the demand. The first edition was printed in November 1919. A French edition was printed at the same time. Early in 1921 a second edition was being printed, which shows that Taverner's innovative method, far from confusing beginners, encouraged many people to take up bird study as a recreation. As an example; a schoolboy by the name of George North, living in Hamilton, was given a copy of *Birds of Eastern Canada* when it was published. As the writer of an "In memoriam" notice for George North put it: "From that point on, birds dominated his life".[62] Another man who bought a copy when it was published, and found it very useful, was Harrison Lewis, then living in Quebec. The demand was so brisk that in 1921 Taverner was asked to produce a companion book, *Birds of Western Canada*.

A modern evaluation of *Birds of Eastern Canada* in historical perspective can be gained by the fact that, when it was reprinted commercially in 1974, it was accompanied by an appreciative Introduction by W. Earl Godfrey, then Head of Ornithology at the National Museum, a position that Taverner had held until 1942. His words were so perceptive that they are quoted at length here:

> "A new era in Canadian ornithology began in 1919 with the publication of P.A. Taverner's 'Birds of Eastern Canada'. At the time it appeared, there was nothing like the book in this country. Not only did it tell the reader just what bird species he could expect to find, but also how to identify each with minimal difficulty by a short-cut method that concentrated on a few diagnostic features, or combination of features, diagnostic for each species and called 'field marks'. Over one hundred species were depicted in natural colors and postures. Data were given on the food habits and other pertinent aspects of the bird, and these furnished the basis for a weighing of the good it does against the bad, and thus people were made aware of the economic status of each bird species. All this (and more) under hard covers sold for just fifty cents!
>
> Taverner was in many ways well ahead of his time. He grasped the value of the 'field marks' method of identification, not yet generally in use. He applied a vernacular name to the species as a whole, rather than treat each subspecies separately under names so different that species relationships were often completely lost. For this, he was rather severely criticized by some reviewers of his book. Taverner's method, however, gradually caught on and time has shown that he was right. In fact, some 38 years after the appearance of 'Birds of Eastern Canada' the standard authority for nomenclature of North American birds, the American Ornithologists' Union's 'Check-list of North American Birds' [Fifth Edition, 1957] adopted the practice of furnishing one vernacular name for the species as a whole, and discarded vernacular names for subspecies altogether."[63]

Taverner explained, in his Introduction, how the book was laid out, and why the classification was different from that used in previous bird books. He also discussed migration, protection of birds, how to attract them, and ornithological books of that time. He explained the use of a key which was accompanied by line drawings of parts of a bird's anatomy by the division's artist, Claude Johnson. This was needed for keying out birds that one had collected. One feature that he had hoped to include was a distribution map for each species. This was thwarted by lack of sufficient information.[64] However, the quality of the reproduction of Hennessey's illustrations in the first printing (1919) was good, and did justice to them. In the second printing (1922) they were rather less clear. A few of the best of Hennessey's portraits were used in Taverner's *Birds of Western Canada* (1926) but had to stand comparison with the majority which were by Brooks. Just a few of Hennessey's best were included in *Birds of Canada* (1934). The printing of these, however, showed them as being much paler than the originals of 1919. One can compare the style, as bird illustrators, of the two men on pages where one portrait by each is shown. For instance Brooks' Red-headed Woodpecker with Hennessey's Pileated Woodpecker (plate 38); Brooks' Western Kingbird with Hennessey's Eastern Kingbird (plate 42); Brooks' Clarke's Nutcracker with Hennessey's American Crow (plate 50). While birds painted by Brooks usually look warm with life and about to fly away Hennessey's were static. They were painted to show the novice the main distinguishing mark of each species, but they are not likely to fly out of the illustration. Two portraits contradict this criticism: the White-breasted Nuthatch and Brown Creeper (plate 52) do have a living quality. Unfortunately, when the plates were used again for the *Birds of Eastern Canada* edition in 1974 the result was disastrous as all the illustrations are drained of colour and are fuzzy. They are unfair to Hennessey's originals.

Finally, some of the species descriptions contain a paragraph of general information, drawn from Taverner's own experience and observations, that are still worth reading today for the insight he displayed into the characteristics of those particular species. For instance here is his comment on the Lincoln's Sparrow:

> "Though a rare sparrow it is an interesting one. It has reduced hiding in brush to as fine an art as any bird. When first disturbed it hops to a branch, where it obtains a good view, regards the intruder for an instant, and then dives into the tangle and is gone. The most diligent search thereafter gives no more than a fleeting glimpse of a brown shadow disappearing into the nearest brush-pile".[65]

For another example of Taverner's comments on a species' characteristics, here is the American Goldfinch:

> "One of the merriest of summer birds, sometimes remaining through the winter in the more southern parts of Canada. It is a great lover of fluffy white thistle and dandelion seed-heads and can often by seen plucking the down, cutting off the fruiting end, and letting the airy tops float away on the wind. Its song is as pleasant as its bright appearance as it sits on some lone elevation and sings *Sweet-sweet-chewit-chewit-chewit* or goes speeding off through the air in a merry flock repeating their cheerful "*Per-chic-o-pee*." The American Goldfinch, though a relative of the Old World bird of the same name, is an entirely different species, named, as the original settlers named many birds, from various fancied or real resemblances to the familiar forms known at home."[66]

Taverner's writings about birds, when he gave his feelings and imagination free reign, contained both scientific information, and an awareness of the living presence of the birds described, blending science with poetry.

### *From The Ottawa Naturalist to The Canadian Field-Naturalist*

> "We have a club here, the Ottawa Naturalists, who are much on a par with the Detroit bunch. They have nice picnics every week but they are no place for you and me. The worst of it is that they have had all kinds of direction with good men, Fletcher, Macoun, Gibson and the whole Geological Survey and that of the Experimental Farm but they haven't evolved a single naturalist in their some twenty five years of existence. The only thing they have got is a publication that has a government grant and appears regularly and in which we can get publication at any time. If it were not for that the real students here would have let the whole organization die a natural death long ago."
>
> P. A. Taverner to Arthur W. Andrews,
> 29 April 1912.[67]

The Ottawa Field-Naturalists' Club was founded in March 1879. The Club published annual *Transactions* for eight years based on papers delivered to the Club concerning the natural history of the Ottawa locality. In 1887 the name was changed to the Ottawa Naturalist and it became a monthly publication. Its scope was widened over the years to include papers by members of the Club on the general natural history of Canada.[68] Taverner summed up the situation of the Club as he saw it after his first year at the Victoria Memorial Museum. As a promoter of natural history study it was rather ineffectual, but it issued a journal regularly in which keen Ottawa naturalists could publish their contributions. This state of affairs continued through 1917 with Taverner, J. M. Macoun, G. Hewitt, and a few others active on the editorial committee. They were already thinking how to make *The Ottawa Naturalist* into a publication that could more effectively represent Canada scientifically.[69] However, early in 1918, there was a "palace revolution", in which the old style journal was supplanted by a new style journal in an improved format and published in April 1919.

The exact details are not known but Taverner told Fleming the gist of what happened. He wrote:

"A few of us got in control and overrode the conservatives and when you get your next number you will not recognize it."[70]

The announcement of the change appeared in the Foreword to *The Ottawa Naturalist* of April 1918 which explained what was happening, and why.

"With the appearance of this number of THE OTTAWA NATURALIST a new era in the history of The Ottawa Field-Naturalists' Club is launched. THE OTTAWA NATURALIST was established in 1887 as the organ of the Ottawa Field-Naturalists' Club. It is now in its thirty-second year and is one of the oldest natural history periodicals in North America. While modest in form and not too prepossessing in appearance, it has published many important papers and the great number of original descriptions that have appeared in its pages makes its files a necessity in libraries of original research in biology.

The time has come, however, when a local periodical of this nature is inadequate and the Dominion requires a more creditable and representative publication for the record and dissemination of the results of scientific research.

THE OTTAWA NATURALIST, with its already established position, long and honorable history and scientific standing, seems a logical nucleus from which such a publication should be developed.

Beginning, therefore, with this number, THE OTTAWA NATURALIST will appear in an improved form. The size is enlarged and the number of pages increased. The better paper used throughout will permit of more and finer illustrations; these will improve the appearance and add interest and value to the magazine. To widen its geographical sphere of influence a change of name to one of less local significance is being considered, but cannot, by the constitution of the Club, be effected until next year."

The statement then explained that for the journal to reach its maximum usefulness the interests of the general, educational and technical public would have to be considered. It was hoped that in future teachers in the various schools of Canada would find *The Ottawa Naturalist* valuable to them in teaching elementary natural science and nature study. Members of the editorial committee had felt for a long time that there was a field in Canada for a journal recording noteworthy biological information as well as bringing pleasure and assistance to nature lovers in general. The proposed increase in size and improvement in appearance would place a financial strain on the club so an appeal was made to existing members to enrol new subscribers. The foreword ended with an appeal to natural history societies through Canada to make this publication indispensable to every working naturalist.[71]

Taverner, writing to Fleming in August, explained their views and objectives.

"We aim to make it a Dominion wide organ and worth while. We have to combine science with popularity on account of circulation but I do not think that will be a serious drawback. Now we want all our friends to boost it. At the next annual meeting of the club we propose changing the name to one of less local character and appeal. We hope to make it the scientific and nature study periodical of Canada".

Writing to his friend Frank Farley, in Alberta, he discussed a friend of Farley's who used to claim seeing rare birds before he was familiar with the common species. Such people were well-meaning enthusiasts, Taverner said, who were usually working without contact with others of greater knowledge and did not realize their own limitations. He added:

"I am in hopes that the new Ottawa Naturalist will assist in this direction [instructing them], including modern systems of zoological work and thought. Glad to hear you approve of it. I would like to get your Alta. Nat. Hist. Soc. interested in it. Perhaps we can when we change the name?"[72]

At that time he also wrote to Robie Tufts asking if he had seen *The Ottawa Naturalist* in its new form, and continued, perhaps with a touch of pride:

"We have greatly improved its appearance and are endeavoring to make it nation wide in its appeal, We contemplate changing its name to something less sectional with the next volume and wish to make it truely representative of Canadian zoology. We think it is time that Canada took her proper place in such matters and that there is room for such a publication. As an educational medium I think it is worthy of all support."[73]

Tufts answered that he would be glad to do what he could to make the Naturalist a success, promised to subscribe to it, and expected to be able to enrol several more people.[74]

Taverner was busy at this time drumming up support for *The Ottawa Naturalist* as his letters to friends indicate. Writing to Swales he said:

"I have been working hard on the Ottawa Naturalist and I think we are going to make it go. It has meant lots of work though and we are not out of the woods. I think we have turned out a presentable publication and with the enlarged field before us can fill a long felt want."[75]

Taverner's friends were encouraging in their replies. Farley suggested the name might be changed to "The Canadian Naturalist". Taverner replied that this title had already been used and it would "ball up the bibliographies if they revived it".[76] However, to get over this problem the title was changed to "The Canadian Field-Naturalist", while the name of the club remained "The Ottawa Field-Naturalists'Club".[77]

Not all subscribers to the journal supported the change of name. Taverner told Fleming of the event in a letter.

"Last evening we changed the name of the Ottawa Naturalist to the Canadian Field-Naturalist and arranged the next volume to be a short one running to the end of the year so as to bring the volume number to correspond with the calendar year".[78]

Fleming was critical of the change. He said it was too bad the name had been changed, and that there should have been a vote taken by the members. He stated that the change in name would not help the journal.[79] In his reply Taverner defended the decision.

"You are mistaken in believing that the change in name will not help the Ottawa Naturalist. It has helped it greatly already. The change in form can only be supported by increased subscriptions and we have to rely mostly on Canadians for this. The jealosy [sic] of anything labeled Ottawa throughout Canada is surprising. We are not going to change anything but the name, — the volume numbers are to run along consecutively so the identity will suffer no break." He also mentioned an index. "A general index would be a good thing but we cannot do it until we get money to publish it. I think I see this in the future".[80]

From January 1920 the number of issues per year was fixed at nine, the jacket was redesigned, and the price was increased.[81]

Taverner had already published a few articles, in addition to several brief notes, in *The Ottawa Naturalist*, before the change took place. At the beginning of 1919 his article "Bird-houses and their Occupants" was published.[82] This was illustrated by a photo of a Purple Martin house with elaborately designed roof and about twenty five martins roosting on it. It was built by Taverner in 1917,[83] and was described in the article, together with two pages of scale drawings and instructions for its construction. The martin house was fixed to a hollow box pole set on a concrete base with a heavy weight inside running over sash pulleys at the top of the pole. In this way the house could be lowered to be cleaned, and easily raised again. In addition to the multi-roomed, colony-home for the martins Taverner showed designs for single room houses suitable for House Wren, Tree Swallow, Eastern Bluebird, Great Crested Flycatcher, Black-capped Chickadee, Eastern Screech Owl, and American Kestrel with the relevant measurements. The two pages of scale drawings by sections, as one might expect of a former professional architectural draftsman, were neat and precise. When the issue of *The Ottawa Naturalist* containing the article appeared in January 1919 it was quickly in demand and in 1920 copies were reprinted for the Canadian National Parks Branch, with the addition of two pages of illustrations of various styles of bird houses.[84] Two further editions were printed, as well as a French version. At the time of its publication there was nothing available on bird houses so well described and accompanied by such clear plans. But then, how many ornithologists were also trained draftsmen?

It would be wrong to get the idea that Taverner took up too much space in the Ottawa Club's journal. In fact he was aware of the danger of the few active contributors on the publications committee giving the wrong impression, and said so to Fleming in a letter in 1918.

"We can nearly keep it going from right here in Ottawa but we want to keep our own names out of it as much as possible so it won't look as if we few wrote the whole thing".[85]

Certainly the year 1919 was an outstanding one for the number of publications by Taverner. Apart from his article on Bird-houses in *The Ottawa Naturalist*, a local list, compiled by him, was printed in *The Condor*.[86] Writing to Brooks at the beginning of 1919 he reported that three articles by J. Munro, B. Bowdish, and himself were all published in the same issue of *The Auk*. This, he wrote, was quite a Canadian number with a distinctly Canadian flavor and "helps to put us on the map".[87] By now Canadian ornithology had taken a big step forward compared with its meagre position in 1911. The Great War was over, and when the New Year of 1920 arrived bringing in the decade of the 1920s Taverner might have looked forward to a bright future for himself, and the ornithology section of the National Museum. By now, however, approaching the age of forty-five, Taverner was experienced enough to look forward, though with cautious hope only.

# Part IV — Ornithology in a Wider Perspective

## CHAPTER 11. Birds of Western Canada: Part 1

"I guess your reminiscences could be written from your letters to me. I have often thought what a valuable acquisition to the ornithological historian some generations hence. They will be a find for somebody."

From a letter by Taverner to Fleming, 16 March 1920.[1]

The decade that began in January 1920 presented Taverner with new opportunities but also new difficulties. He had now been at the National Museum for almost nine years and he brought with him into the 1920s considerable knowledge and experience of what was required of the Dominion Ornithologist. Not least of his qualifications was a growing network of friends and acquaintances in the field of ornithology. He had learned a sharp lesson in 1914 when he was unable to find a competent Canadian naturalist to accompany Camsell on his expedition into the Northwest Territories. From that time onwards Taverner was on the alert to encourage any Canadian who might become a sound naturalist capable of taking part in field expeditions arranged by the museum. He hoped that eventually he would find a few younger men with the qualities needed to lead field expeditions.

In January 1915 a young man by the name of Dewey Soper wrote to Taverner from Guelph, Ontario, asking for advice on how to become a

trained observer in natural science. He wanted to know what kind of wildlife to collect, what notes and observations to make, and what use he could make of photography. He also told Taverner something about himself. He was born near Guelph in 1893, his father was a carpenter who wanted him to follow his profession, but Dewey preferred to work out of doors and earn money by farm work and trapping locally. Soper wrote in curiously stilted English.[2] Taverner seized the opportunity to send this young enthusiast a long letter from an experienced, older enthusiast. In this letter Taverner explained that he had received several enquiries such as Soper's, and he decided to write a detailed reply. He wrote it in the form of an essay with the idea of working it into a paper for publishing and warned Soper "if you see most of it again in print do not be surprised".[3] This material appeared in *The Ottawa Naturalist* a few months later.[4] Taverner outlined for Soper the steps he should take on the way to becoming a good ornithologist, all of which would involve him in a great amount of work. But to the enthusiast this would be a labour of love, and if taken up as a hobby would develop an interest in nature to last the whole of one's life. Sharing this interest with co-workers often was the basis for true friendships, and fruitful associations. Taverner concluded by saying that the museum would be glad to see anything he chose to send, either in the form of notes or specimens. Any time that he could be of any help either with advice, or in the determination of specimens he could call on Taverner. This was the beginning of a long association.

In the next few years Taverner helped Soper by sending him suggestions on how to make good skins, also what to read of a scientific kind about nature. This was in reply to a serious "letter of intent" by Soper about finding his life's work in natural science, and about throwing aside the restricting influence of his vocation (farm work) and launching into the work nearest his heart. He confided frankly to Taverner his hopes for the future, and ended by writing: "Now I sincerely hope I have not unduly imposed upon your time and good will in asking for so much information. As a matter of fact Mr. Taverner you are the only gentleman with whom I might correspond on a matter of this kind."[5] In the same letter Soper asked about openings in zoological work. Taverner was equally frank about the prospects and replied, "The demand for straight scientific work in Canada is very slight indeed, though the need of such work is great... It is to be hoped and expected that one of these days Canada will wake up and resolve to do her own work and not be dependent on American institutions." He then cited his own experience in getting a job at the National Museum by working for years as an amateur ornithologist at some cost to himself. He was lucky to be well enough prepared as an ornithologist, when the opportunity came, to be considered the most promising choice. "It was largely chance and the forming of scientific connections who thought me worthy of recommendation." He continued, "It is too bad that no hope can be held out from this institution. We are in great need of a staff of men but till the authorities above can be made to see that, and this war is over, I can see no hope here."[6]

In a letter to Taverner written in 1918 Soper gave some details about himself. He was a single man, 26 years old, with considerable wilderness experience, who was making a collection of skins, and was known to W. E. Saunders.[7] During 1918 and 1919 Taverner was trying to find him a position as camp-cook/naturalist with one of the Geological Survey teams on a summer expedition, but without success.

In 1918 Taverner heard from Fleming about a Canadian naturalist of promise named Hamilton Mack Laing who was stationed at Beamsville, on the south shore of Lake Ontario opposite Toronto, as an instructor at the Royal Air Force school of aerial gunnery.[8] Laing was born in 1883 and brought up in a pioneering farm community south of Winnipeg, had taught school at Oak Lake in southwest Manitoba, and taken art courses in Brooklyn, New York. By 1918 he had achieved a reputation as a nature writer. Taverner was already familiar with Laing's stories in the two outdoor magazines *Recreation* and *Outing*. In addition Laing could draw well and take good photographs.[9] Fleming used his influence to have Laing offered a job writing nature articles for the Toronto *Globe* which Laing did from 1918 for the next six years. Laing also came to know Hoyes Lloyd who was still working in Toronto before he was appointed to administer the Migratory Birds Convention Act. Fleming and Lloyd suggested that Laing should keep notes on bird migration while stationed beside Lake Ontario, and encouraged him to send the resulting article to Taverner as a contribution for *The Canadian Field-Naturalist* which he did.[10] Taverner welcomed his article, and also wrote an appreciative notice on Laing's articles in the *Globe* for *The Canadian Field-Naturalist* in which he said:

> "The subject of these papers cover such a range of subjects as "Hawks Everyone Should Know," "The Wood Warblers," etc. The subjects are treated in a popular, entertaining manner, in a style that more than occasionally warrants the term "fine writing", sympathetically but with an absence of gush and with a good substratum of personal knowledge and common sense. We can stand many more of such popular science writers in Canada as well as elsewhere."[11]

Laing spent time in the summer of 1919 exploring the Similkameen Valley and hills in the far southwest of British Columbia. He wrote enthusiastically to Taverner on the varied terrain, describing its trees, alpine flowers, birds and mammals with lists of what he recognized. He also took photos.[12] In another letter to Taverner he described the years he spent in southwest Manitoba around Oak Lake between 1901-1914.[13] Taverner realized that he was in touch

with an observant naturalist with qualities that could cause him to develop into a first rate museum collector. In this early correspondence with Laing Taverner took considerable time to help him with information, and sketches on how to distinguish birds such as gulls and geese by their bills, and by various stages of their plumages.[14] A friendship between the two men developed that lasted until Taverner's death.

Another useful contact that Taverner made was with Frank L. Farley of Camrose, Alberta who was a friend of W. E. Saunders. In 1918 Farley met Anderson who was working in the prairie provinces on behalf of the Advisory Board on Wildlife Protection.[15] After Anderson had returned to Ottawa Farley wrote to him as follows: "I have often wanted to meet Mr. Taverner and have him spend time with me on the Battle [river] when he is in the west. Will Saunders always mentions him as a fine bird man, and I like these kind of fellows. Ask him to write me for any information that he might wish as to our common birds."[16] Taverner replied about the possibility of meeting him during his next trip west and added "... don't believe all the nice things W. E. S. says of me as he is a partial judge where his friends are concerned."[17] Farley's next letter was about local birds and where some of them occurred on his farm. Taverner asked him about which species of bluebird(s) occurred in his location. When Farley said that he always thought that it was the Mountain or the Western [Bluebird], Taverner asked him to collect a specimen for identification. Farley wrote that he had seen the first migrants on March 21st of that year and commented: "When I saw the three brave little fellows this spring I could not have killed one for a lot", but added "I will try and bring myself to collecting one next spring and send it to you." He next enquired about the two gulls that Anderson and he had shot and given to Taverner for identification. He had been out with Brooks and Saunders several times, he said, but neither could satisfy him whether the common gull in his location was Bonaparte's or Franklin's [gull]. Could Taverner determine the names of the gulls sent, and let him know what they were. He concluded "I shall be glad to hear from you often, and give information whenever I can."[18]

Taverner responded warmly saying he had received Farley's most recent letter.

> "I was very pleased to get it and anticipate that I have found a very helpful as well as pleasant correspondent. I see much of interest in it. I think we can probably help each other considerably."

Taverner had reason to be pleased since Farley had sent him 23 years of notes for Camrose and Red Deer as a basis for a local bird list. As regards the two gulls, Taverner wrote, the only positive criterion for distinguishing between the Herring and California Gull was the colour of the feet of the adults. On a personal note Taverner commented:

> "You seem to have, like W. E. S., a good ear for bird notes. Now I lack that considerably and rely more on eyesight than ears."[19]

In reply to questions about his list of birds seen in the Red Deer area, Farley sent useful information on such things as the breeding of Sandhill Cranes and Ospreys, among other matters.[20] By now correspondence between the two men began to flow like maple sap in the spring.

Farley gave Taverner useful information on several other matters such as conservation, and Taverner replied with information of much use to Farley. For example, on the decline in bird numbers Farley wrote:

> "The Swans (Trumpeters) are killed every fall and spring here, one man got three in a bunch last fall. Sandhill Cranes are getting scarcer each year, and histories like what I am send [sic] you on the Pelicans might be valuable. All these birds that lay only two or three eggs are more liable to extinction than birds that lay in quantities like the ducks."[21]

This excited Taverner who replied:

> "Swans of all species are absolutely protected by the International Treaty now, but if you hear of any more Trumpeters being killed for heaven's sakes let us get a chance to get them. We will pay at least twenty five dollars for Trumpeters, perhaps more if necessary if I can induce to [the] powers to shell out."[22]

On a different topic Farley wrote about the museum at Camrose, and Taverner sent him information on how to exhibit birds in a museum and what kind of labels to use.[23]

Taverner began introducing Farley to ornithology, and scientific collecting, just as he was doing for Soper and Laing. By now Taverner's network of potential collectors, and sources of information on the bird situation in various localities, was developing well. It was greatly strengthened in 1919 when he received a letter from a man named William Rowan and was able to meet him in Edmonton in 1920 where Rowan had been appointed Assistant Professor of Biology at the University of Alberta.[24] On returning to Ottawa after his western expedition Taverner wrote to Rowan about someone living near Edmonton named Farley. Among other things he said

> "He is a man you should know and I advise you to open correspondence with him. He is a charming fellow and an enthusiastic, if not a deep ornithologist."[25]

In this way Taverner brought together two new members of his corresponding network.

By the beginning of 1920 things in the museum seemed to be going well for Percy Taverner. His group of ornithological collectors had grown and held out promise for the future, his book *Birds of Eastern Canada* was selling very well, and the new *Canadian Field-Naturalist* was well received. But a cloud began to shadow his situation like a warning of troubles ahead. Jim Macoun died on 8 January 1920. Although his death had been expected for the past few months Taverner was upset. His hopes of working under the friendly administration of Macoun, as head of the Biology Division, were

dashed. Taverner could hardly relish working under the supervision of Anderson who had started working at the museum several years after him, when much of the hard preliminary work had been done. But there is nothing in his correspondence to show that he strongly wanted to be chief of division himself. His lack of a university degree, his stammer, his admission that he was not good at managing others inhibited him from applying for the position with conviction. He was resigned to being under Anderson's supervision but consoled himself with the knowledge that he would have considerably more time for his own ornithological work. Writing at this time, Fleming gave Taverner some positive advice when he said:

"However, you yourself have work you like, and can plan it out yourself so you are fortunate. I do not see any reason if the direction of the department were offered to you why you should refuse."[26]

Taverner was not offered the post.

Taverner's change from guarded optimism about the future to one of dismay can be seen in his correspondence with Fleming in 1920. When the Department of Mines was placed under the Minister of the Interior, Arthur Meighen, the opportunity occurred for the museum committee to approach the minister through his secretary and not through the director of the museum, William McInnes, for whom Taverner had little respect. As a result the museum attempted to strengthen its position vis-a-vis the Geological Survey, by asking for a number of changes. These changes, if put into effect, would go a long way towards "the establishment of a permanent and continuing policy".[27] The result of these negotiations for a changed structure was that in December 1920 a compromise between the Geological Survey and the National Museum was made by which the museum became ostensibly a separate branch of the Department of Mines, but in reality not much was changed, and the museum had no separate existence as regard finances.[28] When the National Art Gallery was allotted an exhibition hall in the building Taverner asked Fleming if he would find a way of making public the museum's situation. Parliament, he said, had voted nearly one million dollars to build the structure, it had appointed competent staff, but then had made the value of this investment questionable by failing to provide the proper equipment necessary for carrying on museum work. Instead the authorities allotted space in the museum to the National Gallery of Art for its expanding collection. The public did not appreciate the problems that the museum staff experienced in trying to carry out their work fully and serving the public better.[29]

Early in 1920 Taverner wrote a long and heated letter to Fleming, pointing out the weakened position of the museum committee by the death of Macoun, and now, he wrote,

"Today we hear that Dr. Hewitt who might have been of considerable assistance is dead. Another thing to be considered is the fact that the whole museum staff now is American except myself".

Taverner asked Fleming if he could come to Ottawa and see the minister about the matter. "As Honorary Curator you have a right to say things that we in the service can not."[30] Meanwhile all that the members of the committee could do was to hope for better things when Charles Camsell was appointed Deputy Minister of Mines. He arrived in Ottawa from Vancouver to take up his appointment in June 1920.

Another person, in addition to the Deputy Minister of Mines, who would have an impact on Taverner's future career was Rudolph Anderson, who was appointed acting head of the Biological Division early in 1920. Until that time Taverner had hoped that relations between Anderson and himself would be reasonably satisfactory. But in March 1920, when Taverner could expect Anderson, as head of division, to assume a strong tone on behalf of the museum, Anderson kept quiet. Taverner relayed this unwelcome news to Fleming, and said:

"Have been trying to arouse Anderson but he is hard to wake. Will have to get after his wife, she sees things as they are, and is a hustler and is determined that he will hustle too. Cannot make up my mind just where Anderson stands."[31]

A week later Taverner told Fleming that the museum committee had held an indignation meeting over the reduced allocation of exhibition space, and had requested a meeting with McConnell. It was apparent that the Geological Survey was now indifferent towards the museum, and that Anderson could be helpful if he was prepared to take a firm line. But this was not to be, as Taverner explained.

"The worst of it as it looks to me just now is that Anderson is *not* with us. As I said before I do not understand him as he does not seem to see the absolute impossibility of the proposal as far as a museum is concerned. He seems to think that in demanding what we regard as a minimum space in a building built for museum purposes we are unreasonable."[32]

In his next letter to Fleming he said:

"Anderson did not take part in the meeting yesterday. Do not think he is contemplating leaving [the museum]. He objects but makes no constructive suggestions. Associations with an inarticulate man is a little trying. A man who will not commit himself is always problematical. Have tried very hard to win his confidence but cannot make it."[33]

Taverner's next letter was a very pessimistic one in which he said

"It is yet to be shown that the government is intending to abolish the museum or that it really desires to use a million dollar museum building for offices."

In the same letter Taverner reported a talk with W. H. Collins, one of the leading younger geologists, who was seriously thought of as the next Deputy Minister.

"His feeling towards the museum is one of academic interest but not at any expense of the Geological Survey."[34]

The uncertainties and frustrations experienced by Taverner during the past three months were relieved in April by preparations for the summer expedition. Writing to Fleming he said he was planning to explore an area of sloughs and ponds south of Quill Lake, Saskatchewan, which was a large expanse of uninhabited country where he expected to find cranes "and goodness knows what else". He and Young were due to leave on 1 May.[35] Just before leaving Ottawa Taverner informed Fleming of a more ambitious plan:

> "Have a new plan for the summer. After leaving Young at Quill Lake I may join Lloyd at Banff and come back with him in an auto right across the prairie Provinces, stopping at all the lakes and zig-zagging back and forth for them. This should give a magnificent opportunity for seeing the country and the birds with opportunities for stopping to collect any where along the road. I am getting quite enthusiastic over it. We would camp all along the road and so have evenings and mornings for collecting."[36]

Taverner and Young were disappointed with the conditions they found when they started collecting because a series of dry seasons had lowered the water levels. H. H. Mitchell advised them to try Kutawagan Lake, southwest of Quill Lake, where he joined them early in June. When Mitchell had been at Kutawagan in 1917 there was a large nesting colony of Franklin's Gulls, but by 1920 it had been "dried out", but Sandhill Cranes were found breeding throughout this district, though sparsely. When Taverner left for Banff, Mitchell, together with Young, moved to the southern end of Last Mountain Lake, near the Arm River, where they collected until early September. This area produced a good selection of passerines.[37]

Taverner joined Hoyes Lloyd in Banff in late July and they set out to make what he called in his Annual Report "an ornithological reconnaissance of the provinces of Saskatchewan and Alberta, for the purpose of gaining a general knowledge of the faunal conditions of these provinces."[38] Percy wrote a graphic description of the early stages of the trip in Lloyd's faithful Model T Ford, to his mother and sister.

> "We left Banff with our car piled high with outfit so we look like the real thing I can tell you. Water bags and tent poles tied outside — dunnage bags on each front fender beside the radiator and the rear seat piled full — we in rough clothes. Such an outfit is not too rare out here but we do occasionally excite comment on its completeness."[39]

Everything depended on the satisfactory performance of the Model T which was said to have been completely overhauled in preparation for the journey. It ran all right on the level and the brakes were fine, but its hill-climbing capacity was very unsatisfactory. After several wrong diagnoses nothing but a reboring job on the cylinders would do. This took two days, but after that the car went like new through cactus, sage bush, and desert till they reached Medicine Hat. Now they were in antelope country, and Taverner gave a word sketch of a herd of 12 antelope, "beautiful creatures who galloped away from us in long springing jumps that just touched the ground at each bound".[40] In the same letter he described being shown over the range of an antelope reserve by its warden. He treated them to some fancy prairie auto driving over bumps and badger holes, so that they would have soon been lying on their backs on the ground if the car had not had a firm roof. Luckily the warden warned them that his brakes were poor, and offered them the opportunity to get out and walk before descending into a large coulee between boulders at a 45° angle. They walked. So their journey continued, zigzagging from one place to another, camping the night and exploring in places such as Pokowki and Elkwater Lakes. Since Elkwater Lake was a Forest Reserve Taverner was forbidden to shoot, so he took a half day's rest while Lloyd explored the country, and made enquiries from the local people. Lloyd, on his first trip to the west as Supervisor of Wild Life Protection in Canada, was beginning to realize the vastness of his domain, and the almost insuperable problems he had taken on. Taverner, on only his second trip to the western provinces, was a little frustrated at the lack of time in any one place to observe and collect. Lloyd, however, wanted to see as much of the different habitats as he could, so they had to keep moving. By September they were camping in places in Alberta such as Provost, Buffalo Park Camp at Wainwright, and at Vermillion. Here the superintendent of the park drove them in his car through herds of buffalo, which Percy described to his mother: "It was like the accounts of early explorers as we drove through their dusky ranks and saw a good part of 5000 buffalo scattered over the prairie as far as eye could reach." They camped one night by the Battle River but whether they met with Frank Farley is not known. The car, now called by Percy "Henry", was found to need a new differential axle and new bearings. After that Henry was able to carry them successfully for the remaining 1000 miles of the trip.[41] But before heading for home the two men drove to Edmonton to meet several people. It was here that Taverner first met his new correspondent, William Rowan, now assistant professor at the Department of Biology, University of Alberta. In his field notes for September Rowan wrote: "Tonight [20 September] Dr. Clarke came in at about 9 p.m. to haul me off to the MacDonald [Hotel] to meet Hoyes Lloyd and Taverner who were passing through Edmonton. I had a most delightful evening and came home about 12.30."[42] Lloyd and Taverner returned to Ottawa in October. Taverner summarized the trip in a letter to Fleming as "3500 miles of prairie work" and praised the Ford machine, saying that there were repair parts available "on the notion counter at every cross roads' [store]".[43]

Fleming also had been mixing ornithology and travel while on a visit to England, and in a letter to Taverner described some of those he met at functions of learned societies which he attended, also a visit to the zoological gardens, London, and entertainment including country house luncheon parties. Writing from Oxfordshire he caught the English country house in a few telling sentences.

> "Drove six miles yesterday to dinner at 2 p.m. at a famous house. Pheasant and hare, getting to be quite a gourmand, they certainly know how to live over here. If only they had central heating and baths with running hot and cold water as the Romans had in Britain 2000 years ago living would be the most comfortable in the world."[44]

In mid-April Fleming was in Ottawa conferring with Hoyes Lloyd about a scheme for a major reorganization of the administration of the museum. Fleming told Taverner of the scheme in his hotel room instead of Taverner's office for reasons of secrecy, and they discussed it. The plan was to create a single department of government out of the Parks Branch, Geological Survey and museum, under one executive who would be James Harkin. Taverner then went off on his field expedition to the western provinces, while Fleming and Lloyd continued to develop the plan. In writing Arthur Meighen, then Secretary of the Interior, Fleming outlined the plan, and the part assigned to James Harkin. He also explained to Meighen the reasons for the aura of secrecy under which he was acting. So anxious was Fleming about secrecy that he failed to warn Harkin in advance of the plan, so that when Meighen's letter arrived instructing him to draw up an Act bringing the three departments under one head it came as a complete surprise to him. Early in November Fleming sent Taverner a long letter explaining the proposed act.[45] Taverner read this draft of "An Act to Create a Canadian National Museum" thoroughly, and sent Fleming his comments.[46]

An order in council was issued in November creating the post of a director of a national museum, but by the end of the year that was as far as the plan to separate the museum from the Geological Survey had progressed. The post of director was given to William McInnes, but he was already a sick man when appointed. Taverner sensed that things had gone wrong when he heard that McInnes was to be the museum director, and realized that this probably meant an indefinite postponement to the plan to create one department out of three. This proved to be the last chance for the museum to break away from the control of the Geological Survey and gain a measure of independence.[47] As a result the museum never had a financial basis of its own. Its staff and its finances were under the control of the Geological Survey and remained so until 1947.[48]

We can now turn to the writing and illustrating of *Birds of Western Canada*. Although Allan Brooks left Canada at short notice in 1914, just when the *Birds of Eastern Canada* was being planned, he was lucky to return to Canada alive and in time to start work on Taverner's next book from the beginning. Brooks arrived in Ottawa in April 1919 and went to the Taverners' home. Writing to Fleming, Taverner described his visit with enthusiasm.

> "Am sorry you missed Brooks. He arrived Wednesday and left Saturday night for Vancouver where he is to be discharged. We had a four days wild dissipation of bird talk, and the more I know him the more I think of his ability both scientific and pictorial. He is one of our great men and it is only his extreme modesty that prevents him from being a leader. For wide and deep ornithological knowledge he has Furetes [Fuertes] backed off the boards and his personality is charming. I look forward to being in the field with him this summer. It should be a treat. Artistically I think he has advanced greatly. His contact with English artistic circles has sharpened his esthetic perceptions — a field he always excelled in. The amount of knowledge of birds that he carries in his head is astonishing as I realized when he sat down at the house one evening and drew a Chipping Sparrow from memory that is perfect in detail yet he has not seen one since 1914."[49]

From now onwards correspondence between the two men expanded as they discussed various subjects of common interest. By late 1919 they had begun to exchange birds' skins. Brooks how had a substantial collection but needed more to serve as specimens from which to paint. Brooks sent the National Museum a box of 20 skins, together with some interesting information for Taverner. He reported that from the Osooyos Valley, where he was living, to where the Similikameen hills divide there were five different zones of vegetation caused by the rise of the land from about 1200 to 8000 feet in a few miles. Within these zones he had found a colony of Sage Thrashers, noted that Brewer's Sparrows were common although Spreadborough missed them, and that the first White-throated Swift in Canada was discovered in the crags at the top.[50] Brooks had told Taverner that he required good skins for his work. In reply Taverner had said that although *he* preferred good specimens for the museum he could not be fussy. What the museum needed above all were sets of birds in various plumages.[51] He sent a box of 20 skins to Brooks in return, among which were Spruce Grouse, Willow Ptarmigan, and two Stilt Sandpipers in spring plumage. In the same letter he mentioned that he had been comparing specimens of Evening Grosbeak, and discussed his tentative findings.[52]

Another subject on which they corresponded at this time was the possibility of Brooks compiling a provincial list for British Columbia, or at the least a local list. Taverner heard a rumour from Munro that Brooks had given up working on his Okanagan list, and took Brooks to task.

> "Don't backslide like that". "You are not getting any younger and should you drop out your work will all have

to be done over again — some of it cannot be repeated unless it is put in permanent form. And for goodness sake make it full. What may be an old story to you is news to us."[53]

Brooks replied that he had not "reneged" on the Okanagan list, that *The Condor* wanted a B.C. list. His British Columbia list, when finished, would come out in a Pacific Coast publication of the Cooper Club but was delayed by his lack of records from southeast Vancouver Island. He was convinced that a provincial list was needed, even if it was somewhat deficient.[54] Taverner was anxious to obtain distribution data on the birds of British Columbia for use in writing his book. He warned Brooks not to delay its completion for too long and added:

"You know complete data is never obtained, and however much you have you will always want more."

Brooks had also answered Taverner's request for full details in his list by saying he would make it short and to the point. Taverner answered that he still thought full details should be given.

"Brevity may be the soul of wit but ornithology is no laughing matter and I have found so many difficulties in working up localities from the brevity of notes that I hardly agree with you."[55]

Correspondence between Taverner and Brooks blossomed in the period 1920-1926 because of their common ornithological interests and because of the book on which they were collaborating at that time. Taverner had several problems, though they stemmed from the central one of the correct identification of bird skins. Because of his position as ornithologist at the National Museum he was regularly faced with determining the identification of specimens of birds sent to him from all over Canada. This was not as straight forward as one might think, even when holding a specimen in the hand and comparing it with trays of other specimens. The specimen might have been badly damaged when it was killed, it might have taken several weeks or more to come by rail from a distant part of Canada. This would cause it to lose some of its colour. A satisfactory coloured guide to the birds of eastern or western North America still did not exist (1920).

By 1921 Taverner had officially been instructed by the museum authorities to go ahead with writing a book on the *Birds of Western Canada*, with illustrations by Brooks. Taverner wrote to Brooks with the news saying that the *Birds of Eastern Canada* was such a popular success that a second edition was being printed, and that there would be no difficulty in arranging reasonable terms for Brooks to illustrate *Birds of Western Canada*.[56] Far from relying on other books for accurate colour illustrations Taverner and Brooks had to make their own. Much of their correspondence in this period was concerned with getting information on distributions and making descriptions of the species and some subspecies.

Taverner was among a few ornithologists at this time who wanted to form their own judgment on whether one group of birds was sufficiently distinctive from another group of the same species to warrant it being described as a subspecies. This would involve the addition of a third name (trinomial) to the first name, which identified the genus, and the second the name of the species. A new subspecies would be proposed by a taxonomist and would be based on a group of individuals with similar characteristics in a geographic area. One of the main difficulties in proposing a new subspecies that would be accepted by the AOU committee responsible for revising the Check-list at intervals was to define the differences in colours that distinguished one group of birds from another as a subspecies. Sometimes the nuances of colour differences were very fine. In that case one had to rely as well on such things as slight variations in the measurement of the bill or wing. When Taverner was puzzled by a particular specimen received from, say, southern Saskatchewan, which did not appear to fit the subspecies normally found in the prairie provinces, he often referred to Ridgway's *Birds of North and Middle America* when he wanted to read a detailed description of several allied subspecies. But here another problem arose. Taverner was sometimes unable to reconcile the colours given in Ridgway's descriptions of plumages with those of plumages as seen through Taverner's own eyes. For example he described his problems over colour variations in a letter to Brooks of December 1922. Taverner had looked at 40 specimens of Pileated Woodpecker equally divided between specimens from British Columbia and eastern Canada. He found variations in their plumages from deep black through slightly to decidedly brownish colours, but these colour variations did not appear to divide up by geographical regions. When he laid out a total of 111 Stellar's Jays he found remarkable variations in the blue of the underparts, and the darker blue of the back. Some mantles appeared almost wood brown. In examining specimens from Vancouver Island and the coast, the Queen Charlotte Islands, and the interior the only trend he found was that the Vancouver Island birds were without a white eye spot, while the white spot was found on most of the interior specimens. He added that some day he wanted to study them with more care, and commented, "Large series showing [the] run of collecting and not selected material certainly confuses the most plausible looking layouts."[57] This was the story of Taverner's career at the museum, so much that needed doing immediately. It was a good thing that he was not a married man at this time when he was hustling to do the basic research for *Birds of Western Canada*.

Taverner was unusual in stating publicly that he wanted to form his own judgment on any subspecies, unbiased by hitherto accepted authority. As he

Field camp, Eastend, Saskatchewan, 1921. P. A. Taverner, Alan Sampson, and H. M. Laing. (Reproduced courtesy of the Canadian Museum of Nature, number 53435.)

expressed it, "... too many are guided by preconceptions, and refuse to look facts in the face".[58] Taverner was too frank to pretend to notice a nuance of colour when he was sure that he could not. In his continuing disagreement with Brooks over when to create a subspecies and when not Taverner sometimes wrote that he could not see the colour differences that Brooks declared existed. This exasperated Brooks so much that on one occasion he wrote bluntly, "No good talking to you of color distinctions. I really believe you are slightly color blind".[59] Taverner argued that he was not, and wrote, "I do not *think* I am color blind. Nobody ever admitted such a thing of course, but I have tested myself against others and cannot find any evidence of it." In the same letter he complained that they may have misunderstood each other. "I may not always write perfectly clearly but I do not think you read any too carefully. At least you misunderstand a number of things I have said."[60]

Early in 1922 Taverner wrote a letter to the leading systematics research workers of the AOU enclosing a statement protesting against what he considered was the debasing of the concept of genus in ornithology by the proliferation of subgenera. He claimed that the tendency towards the finer division of the genus threatened to complicate nomenclature and taxonomy until each group in a genus became the private preserve of specialists in that group. He asked recipients of the statement to read it carefully, and return it with their opinion.[61] Taverner must have known that he was "sticking his neck out" recklessly. He might as well have saved himself the trouble, but that was not his nature. By the end of the year he had received only a small number of signatures in support of the statement. What Taverner hoped would be a strong protest to the Committee on Nomenclature of the AOU was, in fact, a fizzle and left Taverner looking a little quixotic. Brooks, who was at Berkeley, California, in December 1922 wrote that Taverner was not satisfied with trying to limit the number of subspecies. Now he wanted to limit the genera. He said that Grinnell, Director of the Museum of Vertebrate Zoology, University of California, and Swarth had discussed the matter with him, and two points struck them. One was that Taverner had only collected 14 signatures out of a total of sixty fellows, and only two were Canadians. The Washington section of the AOU, Brooks said, could start a counter petition and get more signatures than he had for his. Secondly, this multiplying of the genera was nothing new. During the past 100 years

one could trace its fluctuations in the form of a graph — rather like a fever chart — Brooks said. But this was not Taverner's point. He wanted to prevent the proliferation of genera from becoming excessive.[62]

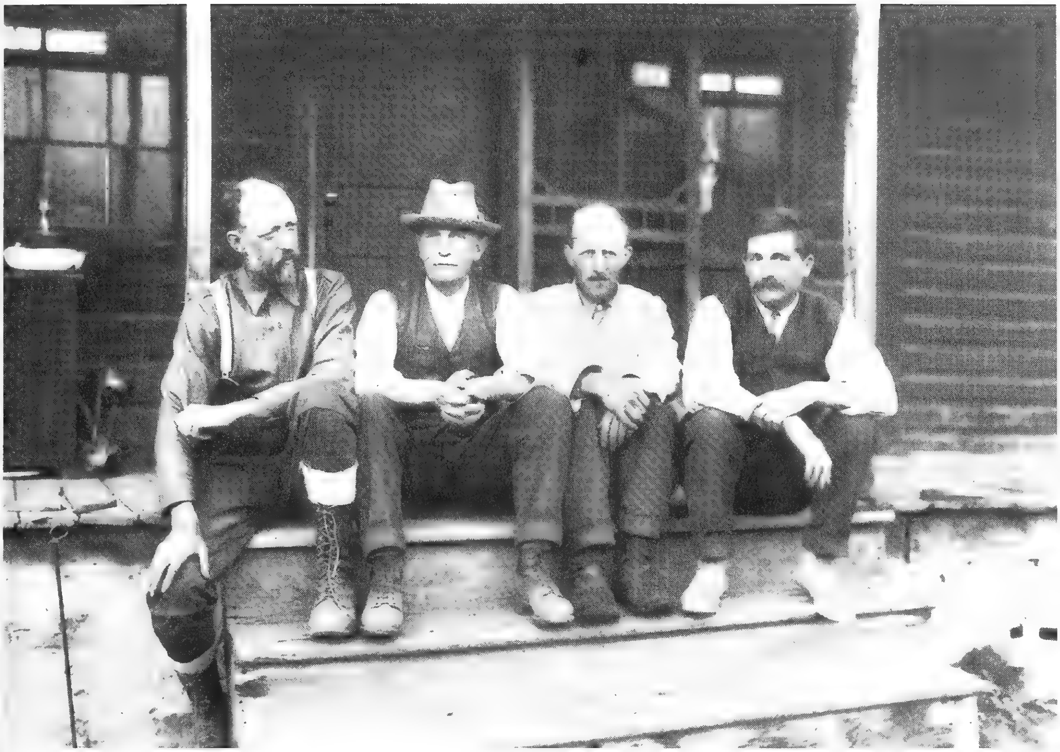
Although Taverner usually lost in his disagreements with Brooks, in correspondence and in person, on problems such as when to accept determinations made by fellow ornithologists, or assertions by others of the true colours of a particular plumage, nevertheless these arguments did much to enlarge Taverner's knowledge of ornithology. The two men remained good friends, and respected each other's sincerity. Taverner gained valuable knowledge from Brooks on such subjects as the physiological structure of birds, and the nesting of various species in British Columbia.

Taverner spent the season of 1921 continuing the "biological reconnaissance" of the western provinces which he had started in 1917 and 1920. He first went to Cypress Lake, Saskatchewan, where Mack Laing, his field assistant for the summer, and Taverner met for the first time.[63] Next they spent a week around Eastend in the French River valley, Saskatchewan, camped at Gower Ranch, owned by a knowledgeable naturalist, Laurence B. Potter.[64] Taverner then joined Hoyes Lloyd in late June, and together they worked through southern and west central Manitoba, collecting museum material from new districts, and investigating bird life in several forest reserves and bird sanctuaries in the prairie provinces. Laing went from Eastend to Oak Lake, Manitoba, where he remained collecting till the end of October.[65] Taverner managed to visit Brooks at his home at Okanagan Landing, for the first time, early in September. In a letter to Laing he described his impressions with enthusiasm.

> "The country about Ok. Landing is very beautiful in every way, well diversified with arid flats, mountains, marsh, lake and hillside. The Bull pines are magnificent with their great red trunks, clean boles and slight underbrush. We talked over bird matters from many angles and though I already knew him fairly well I came away with still greater admiration for Brooks' great store of ornithological knowledge. I know of no one with such a broad grasp of both closet and field information."[66]

Brooks had suffered a setback during the summer of 1921 when a building used for storage and a workshop burned down, destroying part of his earlier collection as well as part of his library and many notebooks.[67] Taverner must have discussed this disaster with Brooks while visiting him in September because in December Taverner wrote with a specification for building a bird museum room. This showed Taverner the draftsman, suggesting a six inch thick concrete wall up to the windowsill, the frame of the building above to consist of stucco on metal lath or galvanized iron. The roofing was to be made of non-inflammable material thus, in Taverner's words, providing maximum fire protection at minimum cost.[68] Taverner had more than friendly goodwill in designing a new building for Brooks' collection. The study skins were made by Brooks himself with noticeable ability, but the fire had been a warning and he began to think of depositing his collection in a zoological museum. Writing to Taverner in August 1921 he mentioned the subject by suggesting that he would be willing to deed his collection and his "new museum building" for cost of the building estimated at $3000, but retaining a life interest and pledging himself to enlarge the collection during his life time. In ten years' time it would be a really representative North American collection. Californian people, he wrote, would jump at such a chance. However, he softened the prospect by saying, "but I would like the collection to stay in Canada as it is just what you need to round out your big Canadian series — enough U.S. stuff for comparison, and the [word illegible] and Mexican species for illustration."[69] Taverner replied as best he could, but he was in a wretchedly weak position. Dr. Anderson, he said, as head of the Biological Division was the logical person to present the idea to the Director of the museum, but he was not yet back from a field expedition.[70] Meanwhile Brooks was faced with a new possibility. In October his friend Harry Swarth of the University of California visited him while returning from collecting on the Skeena River in British Columbia.[71] When Swarth was again at the Museum of Vertebrate Zoology, Berkeley, he wrote to say how impressed he was by Brooks' collection. "The more I think of your collection", he said, "the more I am impressed with its unique value, and it certainly should be put beyond the possibility of damage by fire or otherwise. I have never seen such a series of water birds anywhere — not in numbers I mean but such beautifully prepared skins, such carefully selected plumage stages and such a mass of color notes." Brooks relayed these words verbatim in a letter to Taverner adding that Swarth was unable to persuade the University of California to take up the proposition that he had made to Brooks.[72] Taverner quickly replied, but without any hope of achieving anything through normal channels. He said that he had discussed the question fully with Anderson, and unofficially with the Director, McInnis. As head of the Biology Division it was up to Anderson to push it. He himself had proposed the matter, explained it and urged it as far as developmental propriety permitted. In any case nothing could be done until after the election. Only when the new government was formed and settled could anything be done. Even then, Taverner continued, it would depend largely on the minister we drew in the shuffle.

> "Our present one is hopeless as he had absolutely no sympathy at all with any kind of research work that is not definitely and directly connected with material benefits. I understand he wanted to abolish the museum altogether at one time."[73]



"Asoyoos Meadows" [Osoyoos] south Okanagan, British Columbia. 14 May 1922. Left to right P. A. Taverner, A. C. Brooks, T. L. Thacker, C. De B. Green. Photo by H. M. Laing. (Reproduced courtesy of the Canadian Museum of Nature, 56275.)

By February 1922 the Mackenzie King government was installed and estimates were being prepared. Taverner wrote to Brooks to advise him to send a formal proposal for deeding his collection to the National Museum to the Director, William McInnis, or better still to the Deputy Minister, Charles Camsell. If Taverner presented a proposal to Anderson, and he to McInnis, and McInnis to Camsell, the force of his proposal would largely be eliminated. To ram his point home Taverner added "It takes a dose of H. E. [high explosive] at this end to produce an impression at the other." The analogy to a powerful emetic would have been noted by anyone reading his letter.[74] It was not only the apathy of politicians towards the museum that drew Taverner's anger, it was also the museum being ignored by the wealthy business class. Writing to Laing at this time about the complete lack of funds to purchase anything for the museum collections he said the situation was hopeless. "As for donations, we get so few of them that they hardly count. The American Museum is the one with tame millionaires to buy and donate such things. In this country people regard the government as an opportunity to unload at a gain on, rather than a recipient of donations."[75]

As always it must have been a great relief to get away from Ottawa and the shadow of the government-business world, and be with congenial people in the natural world. In 1922 he was able to leave Ottawa unusually early and meet his assistant Mack Laing at Osoyoos Lake at the southern end of the Okanagan Valley. Here Brooks was installed at a cabin on a ranch at the beginning of May. Many years later, in writing his biography of Allan Brooks, Laing gave a humorous description of his first meeting with Brooks who was at a table skinning a bird. Taverner began to make the introduction: "Hamilton Laing — Major B-B-B" but that was as far as he got when "I'm Brooks" the bird-skinner said, holding out his hand. "Brooks" echoed Taverner loudly.[76] Brooks was on "home territory" and finding uncommon species was not much of a problem. Peregrine and Prairie Falcons on the cliffs, Williamson's Sapsuckers in larch trees at the summit of a creek, and the rare White-throated Swift. This bird was known to occur in Canada only in the southern Okanagan Valley and entailed a climb to crannies high on the face of mountain cliffs to watch them in spectacular flight around their "communal nesting strongholds".[77] On 19 May they

moved to the southern end of Vaseaux Lake where they remained until 15 June when they went to Okanagan Landing for a week. Taverner wrote to his mother and sister from Vaseux Lake with a lyrical description of the scene.

> "We got here Friday P.M. and it is one of the loveliest spots I ever saw. A beautiful green and level valley right at the foot of Vaseux Lake. On either hand rise great mountains, and the exit just below us is framed by a sheer 800 foot cliff, standing up like El Capitan in the Yosemite. We have another comfortable house; about it are apple trees and green, green meadows, punctuated by wonderful bull pines, with forms like Norway pines, but 150 ft. high, and with a golden pink trunk.
> In sight from our window I can see a great Osprey nest in the top of a tall pine. Canada Geese occupied it until the Ospreys drove them off. Out the other window is a flock of 14 Canada Geese feeding in the meadow, not 100 yards away, and absurdly tame. Yesterday Brooks and Laing saw a mountain sheep not ten minutes walk away. Birds are singing all about us. You can see what a beauty spot it is."[78]

When Frank Farley arrived and a hunting friend of Brooks, George Gartell, as well as a student assistant, Alan Sampson, a certain air of light hearted fun, like young men on holiday, developed. For instance in a letter to his mother and sister Taverner wrote that Farley had spent a few days.

> "He surely enjoyed himself, and we did too. Was sorry to see him go. He has all of W. E.'s enthusiasm, and a heart like an ox."

Then Percy related how Gartett drove Farley, Taverner and Laing to White Lake in his car to walk the sagebush area in search of a Sage Thrasher. Although they failed to find one they had a fine adventure on the way back, as Percy wrote in the same letter. They stopped at a Mr. Hady's on Dog Lake.

> "He has a beautiful place, all orchard behind and a lake in front. Porch covered with wistaria in bloom. He entertained us in the basement where he had barrels and barrels of cider two years old, and port wine that would bring a smile of satisfaction to a teddy bear. We were unanimous that a Province where such things could still happen was the country to live in."[79]

This became known as "the incident in Mr. Hady's cellar" among the four men and their friends.[80]

Brooks returned home to Okanagan Landing on 7 June but Taverner and Laing camped for a few days near the summit of a 3000 foot peak to collect species not yet seen. They had considerable luck. First Taverner collected a dark form of the Pigeon Hawk [Merlin], then considered to be one of the rarer North American birds.[81] Both men knew that Brooks had been in pursuit of this dark coastal form for a long time. This is how Laing recorded it in his life of Brooks.

> "It is my considered opinion that Taverner was the luckiest man who ever packed a collecting gun afield. He turned up the most unexpected things, not by special skill but by sheer blundering luck. To prove my point, next day at base camp near Vaseux Lake he returned from a short walk at midday with a Dickcissel, a bird that anywhere west of Manitoba could be called a rare take. This was a new record for British Columbia!"[82]

Since Brooks himself had seen neither a Dickcissel or a male dark form Merlin (*Falco columbarius suckleyi*) in the Okanagan Valley it was certain that he would say that the observer was wrong in claiming he had. Brooks was well known to Taverner for holding an opinion more stubbornly than anyone else — only a specimen in front of his eyes would persuade him. The two specimens, appearing suddenly on the table in front of him came with considerable force. The Major didn't keel over but he went scarlet, and didn't say a word.[83] Taverner and the others spent ten days at Brooks' home where he maintained an unofficial private bird sanctuary except that birds of prey — owls, crows, hawks, magpies and other "undesirable birds" were shot on sight with the result that Brooks had plenty of "desirable" birds to study — almost tame and easily observed nearby. Brooks had this trait in common with Jack Miner — that he alone should determine what birds should remain alive in his private sanctuary. While there Taverner was able to look at Brooks' collection of several thousands of bird skins.[84] Jim Munro, Federal Game officer for the western provinces, came to visit them from his home close by. Another visitor was James Harkin, Dominion Parks Commissioner, which gave Brooks and Taverner the chance to have a good discussion about birds, and especially on the justification for the protection of wildlife, and the conservation of the habitats in which it lived. Harkin was expressing a philosophy for wildlands preservation at this period, and his meeting with Brooks, Munro and Taverner in the Okanagan Valley can hardly have been just for a day or two's holiday.[85]

Since Percy was having such a stimulating time in such beautiful surroundings while his mother and sister were spending the summer at Ottawa and the cottage, which was hardly as exciting as travelling, Percy took trouble to give them any news that he felt would interest them, as well as to reassure his mother that he was in good health. In this way pieces of information can be gleaned from his letters. Taverner was still troubled from time to time while on field trips when he prepared his own skins using arsenic. On the present expedition he was bothered so much by arsenic that he had to give it up altogether. He explained:

> "Am using alum now instead. I did not like to do this, but after all with our good tight cases and liberal use of naphthalene, arsenic is only moral support. Otherwise all is going well."[86]

While at Vaseux Lake he heard of someone called McAstocken who wanted to see him. Taverner had no idea who this was until one day he came to their

Vaseux Lake, Okanagan, British Columbia, 31 May 1922. Left to right, standing: Brooks, Taverner, Frank Farley; left to right, seated: Hamilton Laing, George Gartell, Alan Sampson. (Reproduced courtesy of the Canadian Museum of Nature, number 56293.)

camp, and turned out to be one of the Guelph boys with whom Taverner used to go bird collecting, and they had a great time talking about the old days. When in Penticton one day, while waiting for the boat, Taverner saw McAstocken again in his home town. This is how he described it:

> "Penticton is an ideal little place to live in. Flowers everywhere, every home has nice grounds, and covered with roses. Mountains, and a lovely lake, with a beach where the whole town turns out in the afternoon for bathing. McAstocken has a nice little cottage, four children, two dogs, and three cayuses on which the kids scour the country for miles around. Some life."[87]

In the same letter he mentioned the nearest neighbour at Vaseux Lake was a family by the name of Parham who were friends of Dr. Saunders."[88]

On the recommendation of Brooks Taverner, Sampson and Laing continued their collecting expedition at Comox on the north east coast of Vancouver Island from 28 June until 15 August. While there they collected a Pelagic Cormorant, *Phalacocorax pelagicus*, the violet-green cormorant of the Alaskan coast and south to Washington. While it was still fresh Taverner made a colour wash drawing of its soft parts. The inside of the mouth he showed as pink to reddish colour, while the feet were solid black. This specimen is still in the collection of the National

Museum, Ottawa, and Taverner's drawings on 5 x 8 inch cards, are still in good colour.[89]

On the way from Comox to Ottawa Taverner spent a day in Victoria looking at material in the museum, and spent the evening with William Spreadborough. Writing to Laing, after his return to Ottawa, Taverner suggested that if Laing wanted an interesting evening when in Victoria he should look him up and added, "he has seen more of Canadian wilds than most people and will talk about it by the hour." In the same letter Taverner mentioned a talk with Thompson Seton who came to see him. Taverner wrote,

> "The day after I got home Seton came in and I had to give up all my time to him. He is a genius and an enthusiast even if he has got some erratic spots. It is too bad that his methods of gaining the public ear should obscure the really good work that he has done and is still doing."[90]

Each season when Taverner went on a field expedition he kept daily record books. He sent his notes for the summer of 1922 to Laing. Laing answered, when he had read them, that he would be dizzy for the next few days and added, "That typewriter doesn't spell and punctuate better than it adds 6 + 3. Better get a new one." In his notes Taverner had wanted to use the word butte meaning a steep, flat topped hill, but spelt it phonetically. Laing jokingly wrote: "You really ought to spell "butte" so. Posterity may think you mean a "beaut" of a different sort."[91] This may sound as if Laing, the former school teacher, was trying to teach Taverner the rules of good writing. But this was not a deliberate "put down", because in the same letter he wrote with warm praise for something Taverner had written in his 1922 notes.

> That paragraph on the song of the Yellow-headed Blackbird was the best thing I ever saw you write. You waxed eloquent. I copied it out and put it away. Why don't you ride a tall horse like that a little oftener?"[92]

Taverner answered in the same jocular style, when he wrote:

> "As for the aspersions cast on spelling, I am above such details. Genius refuses to be bound by such technicalities — see how Shakespear spelled?"

Taverner also thanked him for his kind words on the song of the Yellow-headed Blackbird but added,

> "If you were writing for our department you would soon learn to look for small horses to ride."[93]

Laing was a professional writer who was paid to write with a measure of imagination while Taverner was held on a leash of red tape.

## CHAPTER 12. Birds of Western Canada: Part II

During 1923 and 1924 Taverner worked mainly on the first draft of *Birds of Western Canada*, while Brooks worked on the first draft of the "pictures" during 1922 and 1923. Early in 1922 Brooks sent some small examples of what he planned to do. In thanking him Taverner said they were "delightful", and asked the authorities for approval for Brooks to make one hundred illustrations for the book.[1] Taverner wrote to Brooks in September about the book and the list of his planned illustrations, enclosing a copy of a memorandum for him to read and add suggestions. Approval was given for 100 illustrations at $14 each.[2]

Throughout 1923 Taverner worked on the manuscript without going on a field expedition. Much of his time was spent on correspondence with Brooks which included a good deal of technical, ornithological detail. Writing early in 1923 he explained his plan for the book to Brooks. It was designed for the amateur ornithologist, plumage descriptions were only to indicate the main points, though the "distinctions" should be clear enough so that a species could be distinguished from any other species that it might be confused with. As Taverner explained: "I think that a perfectly accurate manual can be made this way without the confusion of elaborate details. Field marks of course [are] self-explanatory". In addition to the illustrations by Brooks small pen and ink figures by Taverner were planned for inclusion in the text. In the same letter he explained that these were intended to point out the field marks of selected birds only.[3] A good example of two such drawings are of the Semipalmated and the Piping Plovers. The head and breast diagrams point out the differences quite effectively. Other of Taverner's figures show eagles, vultures and hawks in flight as well as their heads and beaks, claws, and wing patterns. Many of the readers of the book would collect birds for identification, and would need to distinguish their specimens by measurements and detailed comparisons of wings, bills and feet. This was a demanding task and Taverner sought help from Fuertes on raptors, and from Brooks on field markings of some western birds with which he was not sufficiently familiar.

Fuertes sent him six pages of notes and sketches on hawk outlines.[4] Taverner told Brooks how valuable these were for the book.

> "He certainly has an enormous fund of detailed information on how plumage lies. His rough sketches are beautiful in the certainty of their drawing".[5]

Writing to Laing early in 1924 Taverner said

> "With the advice of Brooks and Fuertes it won't be my fault if the amateur cant identify a hawk at the first flick of its wings."[6]

Taverner was making every effort to devise the best ways, both by illustrations, figures, and in the organization of the text, to present the reader with an

accurate but handy manual without the confusion of elaborate details.[7]

Throughout 1923 and 1924 Brooks was reading sections of Taverner's draft of the text, and commenting on them. Both men were frank with their criticisms. Taverner told Brooks that he was glad to have criticism of his line drawings, and that Brooks would not hurt his feelings by improving his drawings.

> "I do not claim to be other than a conventional draftsman. Pen and ink is not my medium and I do not feel at home in it".[8]

Brooks also criticized Taverner's written material, especially when the meaning was not clear. In reply Taverner admitted one example and wrote

> "I admit not reading over what I write. In fact I know of little that is more disagreeable than reading my own stuff either in letter or in proof and I am a wretched proof reader, and constantly read the thoughts I had in mind rather than what the page says."[9]

After Brooks had decided on which species he wanted to paint he sent Taverner a list of those already painted by Hennessey which, he said, should be retained for use in *Birds of Western Canada*.[10] Meanwhile Taverner was regularly returning illustrations to Brooks with his comments and, when necessary, requests to alter them.[11] Both men were sending frank and voluminous notes to each other. As an example Brooks wrote about Taverner's description of a Western Bluebird as "Abdomen white with a slight bluish tint", the words "Take a look at a good male & see if this is correct. I would call it dull bluish". At the end of this section of comments Brooks wrote

> "I think you have reached a very fine climax in these last two parts. Some of the habit-portraits are the best thing I think you have ever done and I predict that they will be quoted very often in the future. My sincere congratulations."[12]

Taverner could be equally appreciative, praising Brooks' portrait of a pair of Western Bluebirds poised against a background of a bare, curling branch which looks weighed down by the two birds perched side by side on it. They are high-lighted by a two-toned sky, light grey in front and a pale yellow above, suggesting an evening in early spring. By contrast, a pair of Eastern Bluebirds, painted by Hennessey, are shown in the same plate, in much the same pose, but against a pale wash over an empty background. Another portrait shows a pair of Mountain Bluebirds perched on a redstone boulder with a suggestion of vegetation at their feet. In front of them is a mountain valley with a pale apricot wash in the sky. The birds fill almost the whole picture.[13]

But not all their correspondence was satisfactory. They disagreed over the confidence with which even an experienced ornithologist can identify subspecies without first knowing the region from which they came. Lack of sufficient specimens, Taverner said, was largely the reason why he hesitated to use subspecific names where there could be any doubt. He gave examples of problems over the identification of subspecies of thrushes and Song Sparrows.[14] This led to a battle of words which had Taverner writing in exasperation:

> "You are certainly 'sot' in your ways. Made up your mind that I am color blind and cannot be convinced otherwise. You don't get the other fellow's view point even constructively."[15]

Brooks hit back when Taverner would not agree with him over subspecies of geese in North America. He told Taverner that he had studied Taverner's tables on the geese

> "but I absolutely doubt your ability to see *anything* after studying your tables ... on the geese. You are the first man I ever saw who did not see light when he saw real *minima* [*Branta canadensis minima*] — as a matter of fact (from your letter) you did but your sceptical nature at once started to nullify this impression".[16]

Taverner was challenged by enough well-known ornithologists in North America over a long enough time on the subject of not accepting subspecies readily on other people's authority that he acknowledged that he was considered to be something of a maverick. A new Canadian ornithologist had become a correspondent of Taverner's from 1923 onward, Lester Snyder of the Royal Ontario Museum of Zoology, in Toronto. Snyder had written to Taverner for advice on what birds to look for when collecting in the Lake Nipigon country of northwestern Ontario. In due course Snyder sent specimens collected there to Taverner to examine, and when Taverner returned them with his notes and identifications he explained to Snyder how difficult it was to be completely certain in identifying various subspecies of the Great Horned Owl, and the Sharp-tailed Grouse found in the area north of Lake Superior. He proceeded to explain why, and to discuss another species, the [Dark-eyed] Junco. He was by no means convinced that all the existing junco subspecies in Eastern Canada were viable. He cautioned Snyder as follows:

> "One thing I warn you in accepting my opinions is that I am rather of a skeptic and will not receive without qualification postulated subspecies that I can not demonstrate in specimens. I am regarded as more or less of a crank because I will not vouch for what I cannot see, and do not believe in jumping at geographical conclusions."[17]

But although continually attacked in the "bush war" over subspecies Taverner persisted in holding his head up.

Although it must have been quite a strain to keep up Taverner's circle of regular correspondents, he clearly enjoyed the exchange of the latest information on both birds and people. There was no formal style in his letters unless he was writing to a senior civil servant and etiquette required a standard form. Otherwise he seemed to have suited the style to the nature of the man to who he was writing. Like his friends he was a compulsive letter writer. From time

to time he would mention that he was writing his fourth or fifth letter for that evening and he felt worn out. But writing letters was part of his life, something which required a lot of self-discipline to keep up, but something which brought much pleasure. In the days before the telephone was an easy alternative to a letter, writing a letter was like talking to a friend. The writer needed to have a clear image in his mind of the recipient, how he would respond to the subject matter and the style of the letter. In return Taverner would know what kind of letter to expect in reply. When writing to Fleming Taverner gave free reign to his humorous, whimsical thoughts, knowing that Fleming would do the same. They were about the same age. Neither had a university education, and they both expressed themselves freely and equally. His relations with Brooks were a little different, perhaps because Brooks was a few years older and had spent the whole of the war in France where he served with distinction. By the time their correspondence blossomed Brooks had already begun to make a reputation as a good bird artist, something which Taverner had the training to appreciate. The letters between the two men were frank and sincere; they appreciated each other, and exchanged forthright views about the AOU, and other ornithologists, but the tone of Taverner's letters to Brooks rarely contained the banter and leg pulling that the letters between Taverner and Rowan, and Laing did. When you got to know him, Brooks was a good camping companion, but he held very firm opinions. If you disagreed with him you had to be prepared to stand up to him, and argue back. But to do so was a serious business, and could not easily be turned aside by a few witty or amusing phrases.

When writing to Mack Laing, Taverner was on different ground, because Laing was eight years his junior, and because Taverner was a professional ornithologist, and had just written the only bird guide to eastern Canada when Laing got to know him. Fleming and Taverner were both Laing's patrons when he began to develop a new career as a collector and writer. The relationship between Laing and Taverner was an easy one in the early years of their friendship. They both were ready to rib each other, to write at times in a light-hearted style of banter. They had plenty of jokes and fun when in the field together observing and collecting birds. They did not have to feel any sense of rivalry over who was the better ornithologist — Laing had a wider education than Taverner, and was a professional writer while Taverner was an ornithologist with long experience who also wrote well for publication. Much of their correspondence was written in a spirit of exuberant bonhomie. Here were two middle aged bachelors keeping up their spirits from time to time by a slightly artificial style of boyish humour. In the early 1920s, each may have needed the other to talk to, a congenial person with whom to share recent experiences and present enthusiasms, someone to buoy him up over the low points in his work, in particular the absurdities and the red tape.[18]

Another recent correspondent of this period was William Rowan. Writing to Brooks in late 1923 Taverner said:

> "Rowan is a great acquisition to Canada & is going to do something worth while for Alberta. His list of 30 species of waders seen at Beaver Hills L. [Beaverhill Lake] in May is a stunner. ... Rowan is very much taken with Harold [Harrold] and not, I believe with Soper, and you see the best (& the worst) of a man when you are camping with him."[19]

The tone of Taverner's correspondence with Rowan was a little different from that with other major correspondents in the period, perhaps because Rowan had a very different background and training. Son of an Irish father and a Danish mother, he attended an English Public (i.e., private) school, enrolled in London University where he graduated with a B.Sc. in zoology in 1917, and an M.Sc. in 1919. By this time Rowan had become interested in the distribution and breeding biology of birds in Britain. As a boy he had been impressed by illustrated lectures given by Ernest Thompson Seton, and decided he wanted to become a naturalist in Canada. The time was opportune; the war was over, the universities were appointing academics in zoology. Rowan accepted a post as lecturer in zoology at the University of Manitoba in Winnipeg, in 1919, and was appointed the following year to build up a Department of Zoology at the University of Alberta in Edmonton.[20] Rowan was already in touch with Taverner in late 1919 from Winnipeg and a regular correspondence soon developed. He was glad to refer to Taverner for information on ornithological questions, especially since Taverner was working on a book about birds of western Canada. In addition, Taverner could keep him posted on what was going on in the field of ornithology, not only in Canada but also in North America, through the AOU. Above all Taverner introduced Rowan to other ornithologists at this time when Rowan was rather isolated in Edmonton. Some quotations from their correspondence will show this relationship. For instance, in March 1922 Rowan wrote:

> "Another long letter from you, for which many thanks. They are one of the things that make this crowded life worth living."

Later in the same letter he wrote

> "I do hope you do not mind being bombarded with my perpetual queries. I must waste an awful lot of your valuable time. It is not often one gets the opportunity of talking birds here reasonably with any one."[21]

Taverner, from his point of view, was willing to spend a lot of time writing to a man of Rowan's training and enthusiasm, who was collecting and studying birds in the prairies. This was expressed clearly by Taverner in August 1922 when he started a letter:

"Dear Rowan;
Bully for Rowan. Glad to see that he got so much good stuff. I foresee that one of these days Canadian Ornithology is going to come into its own. Brooks collecting in B.C.; you in Alta.; Mitchell in Sask.; Harrold and another young fellow of whom I see promise in Man. besides the few in Ont. and Mousley in Quebec makes the future look rosier than it has ever [been] before. I hope that I have been and may be in the future some little influence on its development."[22]

That Rowan was now settled in Edmonton with zoology students, and a keen group of men joined him at Beaverhills Lake to hunt water birds was, for Taverner, a great stroke of luck. Not only did he receive new records and specimens from Alberta, he also got excellent information for his book *Birds of Western Canada*. Each man appreciated the help of the other, and said so. This is Rowan writing to Taverner near the end of 1922. "I think you are one of the best letter writers in the country. Many thanks for the last which was, as always, full of interesting information." In the same letter Rowan mentioned that although he was fond of collecting study skins his real interest lay in problems of migration, dispersal etc. "that can be so admirably studied out here where one has the ground to oneself."[23] In response to a request from Rowan about what studies had been written on birds introduced into Canada Taverner sent him information on: [European] Starling; [Ring-necked] Pheasant; Hungarian [Gray] Partridge; Mina [Crested Myna]; [Eurasian] Skylark among other species.[24]

Both men had a strong sense of humour and the ability to laugh at themselves. The topic of bad spelling came up early in their correspondence and each recognized the other's weakness. Rowan once wrote "cheque" when he meant "check".[25] Writing to Taverner to thank him for a letter, Rowan put the matter with a touch of whimsy;

"I wonder whenever I get one of your delightful letters which of us would win out in a competition for rotten spelling. I used to think I was unbeatable … "[26]

Taverner replied also with a touch of whimsy:

"Don't rub it in too hard on the spelling. If the Dept. were richer I would have a ten dollar a week stenographer to attend to those details for me. As it is my mind outruns my fingers and this machine doesn't know the first thing about spelling."

But he ended the topic on a serious note when he said

"I hope that you, like me, believe that the sense is the important essence."[27]

Taverner's personality was a little unconventional. He had a creative rather than a strictly "play by the rule" mind. So did Rowan who replied with a witty thrust.

"I'll forgive your rotten spelling. A rival is always a good thing."[28]

However, most of the Rowan-Taverner correspondence was about ornithology, Taverner commenting on Rowan's records of birds collected and records of birds made at Beaverhills Lake, and Rowan commenting on his frustrations over not receiving permits to collect, as well as a strongly-worded diatribe against Harrison Lewis, editor of *The Canadian Field-Naturalist*, for suggesting "vermin" such as crows and coyotes should be exterminated.[29] Taverner had already had some experience of Rowan's impetuous nature when frustrated, especially over matters affecting his research, and his tendency to send off sharp letters of complaint without thinking of the consequences. Several times Taverner had warned him to be careful. About his criticism of the vermin matter Taverner wrote:

"Constructive and sympathetic criticism is helpful but look out that you do not encourage attack that may … cast discredit on the whole movement."[30]

Later Taverner wrote that Lewis would not alter his beliefs once formed.

"Lewis is all right. He is very set in his ways but very conscientious and painstaking. He is open to conviction but awefully hard to convince. He will be absolutely fair according to his lights but wont compromise them one bit … There are a great lot of his type among the bird protectionists and they can not be overridden roughshod as I fear they are the majority among the active powers. They got control of the Audubon Society a few years ago. Educational work has begun to lower their influence and sanity is reappearing …"[31]

About this time Rowan was in a state of anxiety over a questionnaire that all Alberta permit holders had received. If permits were cut down he would lose skins sent him from various parts of the province, which might upset his research work. "For the love of Pete", he wrote, "if you get the chance, dig Lloyd in the ribs and get him to hustle things."[32] Taverner sent Rowan's letter to Loyd who replied:

"Dear Percy. Tell Rowan to keep his shirt on. There are dignities to uphold on both sides, but we will always do anything in reason within the constitution."[33]

As a result Taverner wrote a diplomatic "soothing down" reply to Rowan's letter, the first of a number of such letters that Taverner would be required to write.[34]

In November 1925 Anderson and Taverner attended the American Ornithologists' Union (AOU) meeting in New York and presented an official invitation from the Minister of the Interior, Museum officials and the Ottawa Field Naturalists' Club, to hold the forty-fourth stated meeting of the Union in Ottawa in 1926. The invitation was accepted and the date was set for October. This would be the first meeting of the AOU to be held in Canada. In addition to the program of talks, meetings and an art exhibition, planning for several other events was carried out from the beginning of 1926. For Taverner and Brooks the main event was to be the presentation of a copy of *Birds of Western Canada* to each AOU member attending the meeting. This meant that it was urgent to begin the process of printing the coloured plates, and Taverner wrote to the Editor-in-

Chief at the museum setting out what would be required. The technical language used by Taverner in explaining this shows his familiarity with terms used in art printing.[35] Taverner then had a meeting, which he jocularly referred to as a seance, with the printing bureau. This he reported to Brooks in the technical terms used by engravers.[36] During 1925 and early 1926 letters went back and forth between author and illustrator on the printing of the book. But these letters also touched on the wider purpose of the wildlife artist, and the skill required by him to make his illustrations live. Brooks told Taverner how he had painted a picture of waveys (Snow Geese) but it did not turn out as he wanted. He explained why, and what he would try to do next time.

> "Composition is everything. If I try it again there will be nothing but Waveys on one plane, quite big and only a solid blue sky."[37]

While at the AOU meeting Taverner went to see Audubon's original paintings of North American birds owned by the New York Historical Society. In a letter to Brooks he remarked that there was considerable discrepancy between the colourings of these originals and the colourings in the editions printed from them.[38] Brooks replied with an account of work done by Audubon's contemporaries in France, studies of dead game birds coloured on copper plate, "of exceptional merit made about that time. The trouble with Audubon", he wrote "was his absurd method of crucifying his subject on a board; he never looked at a live bird [while doing it]". Brooks then described the old style of reproduction, hand coloured on copper or stone engravings, and how it was carried out.[39] Meanwhile Taverner was wrestling with the problems of printing the coloured plates of their own book as he explained to Brooks in January 1926. Originally he had expected it would take a month to run the edition but had now learned that nearly half a million impressions would be required and that these would take four months to run. The complete text was now printed but if everything went well it would be mid-June at least before the complete edition would be ready for distribution. Taverner added:

> "I will certainly be relieved when it is all done and off my hands. Think I will swear off making books then, especially under official auspices."[40]

At last, in March, Taverner could write that the edition was all printed, that the new paper for the coloured plates had arrived, been seasoned, and that printing was ready to start "next week". He added some technical information for Brooks' interest:

> "We have put the fear of the Lord into the [Printing] Bureau in general, I think, and within a few weeks and before the weather makes a marked change they will have four presses on the job so there will be as little time for atmospheric changes in the paper between printings as possible. When you come down to the details of this color printing one is surprised at the enormous difficulties that have to be surmounted. Saw a case yesterday where they turned the heat off the printing room over a week end and Monday morning the paper was nearly one eighth an inch out of register. Hygrometers show the Ottawa air in winter approximately bone dry while in summer it nearly approaches saturation mark yet we have to straddle these two seasons now and keep register. With four presses going, one on each color I think we can get results. I think you would be much interested if you were here and could see the job through right with the men on the machines rather than with the men in the office. It raises ones confidence in the Canadian workman. As the plate printing will take about 3 months I see no reason why the book will not be out in June and ready for distribution by July. However it is always the unexpected that happens and this book seems to have had a hoodo so I won't make any promises. I hope it will be ready for the A.O.U."[41]

Because Brooks and Taverner could not talk to each other on the phone they had to keep up their "long distance conversation" by writing an intermittent series of letters. Their main topic was birds, and the handbook they were working on together. But also they wrote about artistic matters, travel and mutual friends. They seem to have enjoyed their correspondence in these years, perhaps because they had much in common to enjoy.

Early in 1924 Taverner wrote to Brooks that the Biological Board of Canada was interested in publishing a fauna of the Atlantic Coast. It was to be a students' manual and Taverner had been asked to write the bird section. His contribution would be to show the influence of the birds on marine life of the Atlantic coast. He would be able to include all the line drawings he wished. Writing to Rowan he said that his contribution would be rather more advanced in content than either his *Birds of Eastern* or *Western Canada*. It would be rather a large undertaking, and would be likely to keep him in Ottawa for the summer.[42] However, Taverner managed to visit the seabird breeding colonies on the north shore of the Gulf of St. Lawrence where he took photographs, and a man from the Canadian Government Motion Picture Bureau, Department of Trade and Commerce, took films of the birds. In theory the trip in July should have been successful and enjoyable but in fact it was a failure. Harrison Lewis, the Chief Migratory Bird Warden for Ontario and Quebec, arranged for Taverner to come with Lewis in his boat. Let Taverner explain what went wrong in his own words in a letter to Fleming.

> "The boat Lewis has is a very nice little cruiser and had she been properly fitted with lockers and stowed would have been very comfortable. Lewis is a good sailor but has no more idea of keeping things ship-shape than he has of collecting. As long as his boat goes and is sea worthy, nothing else is worthy of attention. Had not even pots and pans to cook with nor nearly enough knives, forks, plates, cups or spoons to go round, so we had to eat in relays. Also thinks boiled potatoes with an oxo cube and ships biscuits without tea is an abundant feast. In fact the whole living conditions aboard were impossible. The fact that all this discomfort was unnecessary was what got my goat...

"One thing we did have and that was good fish. Fresh cod is my favorite fish and we had quite a lot besides salmon, trout, and capelin. The latter are delicious. Also had quite a number of lobster. However if we had not bought them from the fishermen we would not have had them. Lewis seemed to think that he was not justified in buying food on the coast when he had outfitted in Quebec. This is not a departmental ruling, but he is a funny fellow indeed."

Taverner ended the letter with the wish that Fleming and his family lived in Ottawa, something that he had said several times in the past: "I do wish you lived in Ottawa instead of Toronto but that is another thing that cannot well be helped."[43]

In order to complete his manual of birds of the Canadian Atlantic Coast Taverner needed to add the common names in general use among fishermen and sportsmen of the marine birds. Lewis had given him the names for the north shore. Now Taverner wrote to Robie Tufts, Chief Migratory Bird Warden for the Maritime Provinces, asking for names of the south shore birds. This was a difficult letter to write because Taverner had heard, through Hoyes Lloyd, that Tufts was "somewhat put out at finding a set of Sharp-tailed Sparrow eggs that he collected in the hands of some American collector". Since Tufts had presented this rare set of eggs to the museum Taverner had no excuse to offer. He tried to bluff it out by saying that his assistant, Young, had assured him that he had found several Sharp-tailed Sparrow nests in Nova Scotia in 1910 but none had eggs. He made the matter worse by admitting the set had been exchanged with the professional collector, Edward Arnold, for other items. He compounded the injury by saying that he was not much of an egg man, but was satisfied with the material the museum got in exchange.[44] But that was not the point. The eggs were rare, the museum did not have another set, Tufts had donated them, and they should not have been exchanged. In his reply Tufts said that he was very sorry to learn that this set, the only one he had ever known to have been taken, had been removed from the Government collection.

"Your utter lack of appreciation of these rare eggs was rather galling to me, I confess, and I can hear Mr. Arnold chuckling to himself now as he put this one over on you. However, the set has found its way into the hands of a particular friend of mine who greatly appreciates them on account of their rarity as well as because they were collected by myself, and these facts help soothe my injured feelings somewhat."[45]

Taverner was still trying to justify his action in his next letter to Tufts when he wrote:

"Don't worry over those Acadian Sparrow [Sharp-tailed Sparrow] eggs. Arnold may have his chuckles but we have ours as well. From Arnold and through him we have obtained several hundred sets of eggs besides a number of skins including a pair of Passenger Pigeons, — all without cash cost to us".[46]

No amount of explanation could bring back Tufts' gift, and the episode left him feeling sore. The problem of how decisions of exactly what specimens should be exchanged from a collection of a museum, and who should make the decisions was to arise from time to time in the future, and will be discussed in Chapter 14.

A problem which was on Taverner's mind at this time was the health of his mother. Apparently she had been "going down" for the past two years, but in the spring of 1924 she had her tonsils out. In his over optimistic way in matters of health he reported that she was now her old self again. He also said that he had suffered from "rheumatics" for the past year or so, and was now going to have his teeth out, and added "think it will fix me up again."[47] In July Martha Wiest, an old friend from Detroit, had come to the cottage to be with Taverner's mother. When she left to fetch her son from a summer camp in mid-August Mrs. Taverner went with her to their home at 45 Leonard Avenue in Ottawa. On September 1st Ottawa friends of the Taverners, Dr. and Mrs. Charles Saunders, who had recently returned from a two year absence in Paris to study the French language, came to visit them, which Mrs. Taverner enjoyed very much. The next day Percy and his mother, with Martha Wiest and her son Karel, returned to the cottage, while Ida expected to go up the following weekend. They spent a quiet few days at the cottage but then the weather changed and on the morning of September 5th was very windy. Mrs. Taverner had an asthmatic attack and died. Percy described her death in a letter to Fleming.

"I never saw her in better health and happier than she was the last week and even up to three hours of her death. However it was as easy a passing as could be imagined and she did not even suspect there was any danger until she lost consciousness. Just two weeks before it happened I managed to get a great lot of unusually satisfactory pictures of her in the garden. We are thankful to have very beautiful memories of our mother. We will miss her greatly and it will throw considerable burden on my sister. We contemplate making no more changes in our living than necessary."[48]

Taverner also sent the news to Brooks in which he said, in part:

"I suppose that you have heard of the death of our dear mother... Ida and I are closing up as best we may but there are not many men of my age that are as close to their mother as I was and we feel her loss sadly. Our consolation is however that we made her happy after a particularly bitter life and her passing was peaceful and even without anticipation."[49]

Brooks wrote with his sympathy, and thanking for the press cutting which he was glad to have. "Your mother", Brooks said, "spoke so little of her past, she was always so interested in the present, like all big-hearted people are."[50]

Mrs. Taverner was in her seventy-first year when she died. She was buried in the family plot (Section 50, Lot 63) in Beechwood Cemetery, Rockcliffe,

Ottawa.[50] At that time Percy was 49 and Ida Clare 37 years old. The family of three had remained closely together since Ida's father had ceased to visit her mother nearly thirty years ago. They had always helped each other, and shared their resources and to some extent their friends. Ida Taverner had worked for the Order of Foresters when they lived in Detroit but when they moved to Ottawa she was able to live in a different style with leisure to develop new interests. As the family found new friends Ida Taverner found herself entertaining interesting people whom Percy invited home. Their Ottawa house was considerably larger than the one they had moved from in Detroit, and had a style all of Percy's own design.[52] The garden gave his mother a great deal of pleasure during the last years of her life. At the end of 1922 Percy had the porch glazed in, but with a moveable sash so that it could be opened in the summer. As he told Brooks: "It makes a lovely study and extra sitting room, half conservancy."[53] Since 1914 Percy had put much hard work into developing an attractive garden with a lily pool with gold fish and water lilies in it, and a Purple Martin house beside it. A photograph of 1923 shows the Hoyes Lloyds' three small children by the pool, and behind it a lattice-work fence and ornamental gate with a flower border with tall hollihocks in flower in front, and the martin house seen just behind the gate.[54] The rock garden, for which the Taverner home became well known did not reach its zenith until the 1930s.

Taverner's idea of a holiday at this period in his life was not of lazing about but rather some activity that was different from his usual work. In one entry in the Hyla visitor's book Ida noted: "Percy's ardent desire to be always improving the place spent itself in building a chair with birch legs which mother says is quite beautiful."[55] The same was true of their home at 45 Leonard Avenue where Percy spent his spare time working in the garden, or in the basement making Christmas presents for his close friends. For Christmas 1922 he sent Brooks a little statue of a Gyrfalcon for which he had made a mould twenty years previously. In thanking him Brooks called it a thing of beauty.[56] Another present that he regularly gave to his friends was his own Christmas card. First he made a mould of it, then he could "pull" from it the number of cards he required. Another kind of activity was to bind a book as a present. In 1925 and 1926 he was particularly active in his hobby of book binding which he explained in a letter to Laing. "Have been binding all winter", he wrote, "and my bookcases now look quite imposing with all the paper backs properly covered with leather. It is nice work too and not difficult if you have manual dexterity and know how. Would be glad to show you some time."[57] It was a psychological release from typing letters and examining skins, and gave him a feeling of satisfaction to see the results of his manual skill. As a special present Taverner bound a copy of Laing's account of the expedition he made as museum naturalist in the *C. G. S. Thiepval* in 1924 from Canada to northern Japan including Alaska, the Aleutian and Kurile Islands, and Hokkaido, with some chance of collecting specimens.[58]

Another friend to receive a book bound by Taverner at this time was Allan Brooks. This book was the result of a collecting expedition to Atlin Lake, British Columbia, during June through August 1924 undertaken by Brooks and Harry S. Swarth.[59] During their stay there they collected ten Brewer's Sparrows high in the mountains at the timber line. These specimens were sufficiently different to justify describing them as a subspecies of Brewer's Sparrows. They named it *Spizella breweri taverneri* in honour of Percy Taverner.[60] As a result of their studies and collecting of British Columbia birds Brooks and Swarth compiled a provincial list which Taverner had been encouraging Brooks to make earlier. It was published in 1925 under the title *A Distributional List of the Birds of British Columbia*.[61] This was the book bound by Taverner as a gift to Brooks. Taverner not only obtained a copy of the provincial bird list for British Columbia which he wanted, he also had a new subspecies named after him.

Another aspect of Taverner's artistic appreciation came into flower in 1925. As a result of his mother's will he was able to start buying the first of paintings by bird artists. A painting by Brooks at the AOU meeting at Pittsburgh in November 1924 of a Golden Eagle was for sale. Taverner wrote to Brooks asking if it had been sold yet, and how much he was asking. He explained "I am going to buy a few such things but though I do not want to compete with more affluent purchasers I do want some more of yours."[62] At the same time Taverner wrote to Fuertes confirming his conversation at Pittsburgh asking him to paint a picture for him on the general lines of his "Geese going south". The size he left to Fuertes — "the best you can do for one hundred dollars".[63] Fuertes replied warmly:

> "I am greatly delighted; nothing in the whole course of my career pleases me as much as to have my feller [sic] ornithologists order my stuff, because I know it is because they like it for the reason I like to do it, and it is the most honest-to-goodness tribute my work could or ever does get."[64]

The painting was 36 x 24 inches, and arrived safely, getting through customs without any difficulty.

Meanwhile Brooks replied that the Golden Eagle had been sold to a man in New York for $120. After further correspondence Brooks sent four paintings for him to choose from. "Take your choice" he wrote. "Eagle $100; Coots $75; Waveys [Snow Goose] $50; Heron".[65] Taverner chose the eagle. He liked the Snow Goose next, and the heron last because he considered it "a little too chromolitho graphic, and contained at least three different pic-

-tures".[66] In a later letter Brooks added a P.S. "You are quite right, I think, about the Heron picture. Wish I had you to criticize as I make 'em".[67]

The year 1924 had been a bad one for Percy Taverner. Apart from his mother's death he had been working very hard all the year with very limited recreation. In contrast 1925 was exciting, both as regards museum studies and field work. Starting from September 1924 correspondence between Taverner and Rowan contained information about Rowan's early research into the problems of bird migration. But first here is Taverner thanking Rowan for the bird records from Alberta that he kept sending him.

> "Now here you add Pine Warbler and the Dickens knows what. Well, we are finding out something about prairie ornithology now. It takes the resident observers to get down to brass tacks. I see that you have enough to transfer to my files to keep me busy the rest of the afternoon."[68]

Rowan had written to Taverner in early 1924 about Beaverhill Lake in the spring migration, inviting him to come. It was an enthusiastic invitation in which he told Taverner that he had learnt a lot from their regular correspondence of the last few years, and had derived lots more pleasure from it than he could well say.

> "If I have teased you a bit more than I should from time to time, that's part of me and can't be helped. But there are a lot of things one can't write about that one can discuss, and I need not say what a delightful treat it would be for me if you did no more than spent just a day here."

He explained that the C.N.R. passed through Edmonton, that the last stop before Edmonton was Tofield, and that every train stopped there. All he need do was to get out there.

> "The taxi man will meet you and take you right to the front door of the tent, 4 1/2 miles for $1.50 and no hotel expenses at the other end. You will then see the finest wader ground in the Dominion."

After telling him all the good birds he was likely to see: Hudsonian Godwits, Buff-breasted and Stilt Sandpipers, Smith's Longspur, Ross' Snow Goose [Ross's Goose], Richardson's Merlin; he ended by promising:

> "You will never feel sorry for it, and it will keep me going for another year or two. We get completely starved for decent company."[69]

Rowan clearly found Taverner a congenial companion, and someone on whom to try out his theories while formulating them. Rowan's biographer, Dr. Marianne Ainley, referred in her thesis to Taverner as "Rowan's long-distance mentor". She also suggested that Taverner's comments on the reactions of birds to different migratory situations caused Rowan to insert a section in his 1926 paper on this question.[70]

At this time an amateur ornithologist, the Reverand Gustave Eifrig, had had an article published in *The Auk* in which he doubted that birds migrating in spring were influenced by any physiological stimuli.[71] Rowan had been formulating a hypothesis of his own at this time to show that some species *did* receive external stimulus in the spring. In October 1924 he began experimenting with juncos by giving them additional minutes of artificial light after sunset. He published an account of his first experiments in the English journal *Nature* in April 1925. From this year onwards his letters to Taverner reported, in some detail and with obvious excitement, how his experimental work was progressing. He enclosed a copy of the article in *Nature* for Taverner and commented:

> "I believe this bit of work of mine is the first attempt in history to prove any of the migration theories experimentally."

Rowan also enclosed a copy of "an onslaught" on Eifrig's article mainly written in July 1924, and commented

> "I seem to have jumped hard on Eifrig but really haven't done so nearly hard enough. To my mind it is an indefensible procedure to crib a good idea from a couple of botanists, stick it onto birds, and make it apply without a moment's thought."[72]

At this point Taverner met someone who became another member of the naturalist-collectors of his western network. This was Cyril Harrold, who had come to Canada in 1914 at the age of eighteen. He was saved from joining the forces because of defective eyesight, and instead spent the war years in the dangerous work of manufacturing explosives. All his spare time was spent in studying and collecting birds. After the war he came to Winnipeg with the object of making a career in ornithology. He learned the art of taxidermy, but was far more than a bird collector, and a sound education gained in England with a grounding in Latin, and a knowledge of French and German were useful in his study of ornithology. He was especially interested in the problems of migration and distribution, and was a first-rate field man.[73]

Taverner started his field work for 1925 by a second expedition along the Red Deer River with Harrold as his assistant. Starting from Red Deer on 20 June they reached Drumheller in July where that part of the trip ended. Taverner was anxious to increase his knowledge of the raptors of that area begun in 1917. New information on distribution, behaviour and relationships was gathered. From Drumheller they went by train to a point near to Charles M. Sternberg's camp where a group of museum men were digging for fossil remains of dinosaurs.

Percy wrote an informative letter to his sister Ida, who was on a trip to Europe with a group, about their Red Deer trip. He described Sternberg's camp, with its team of horses and a farm wagon as well as Sternberg's prized tin Lizzie (Model T Ford) which he kept covered by a large tarpaulin — rain or shine. Apparently Sternberg was a bit downhearted at not

finding anything of particular interest until he found a really worthwhile specimen. Taverner thought it was a carnivorous dinosaur complete except for its skull. It was in an undivisible mass of over 4000 lbs weight; quite a challenge to extract. Taverner, in contrast, found nests of a Say's Phoebe, and a Rock Wren which he crated with the plaster moulds he made of whole sections of cliffs to support these nests for exhibits. He told Ida that he had been making a lot of movies for Sternberg. "If they turn out well", he said, "they should make a very good picture we can call 'Hunting Dinosaurs in the Bad Lands of Alberta'." He also took a lot of stills and movies of birds. Conditions were not entirely comfortable because of the weather. It was extremely hot, and the steep river banks and cliffs made it stifling. One night in camp there was a gale which blew off the awning fly, and then the main fly over the tent which ripped it badly. Harrold and Taverner spent all day sewing it up. Frank Farley joined them for a few days and won all hearts by his enthusiasm and energy helping to get some heavy specimens into both wagon and boat. He ended his letter with a P.S.

> "Getting along with my teeth, but if it were not for the experience of others would declare that one never could use them in comfort or with efficiency!"[74]

Taverner left Sternberg's camp about 20 August (Harrold had left earlier) and went by train to Tofield station and then by car to Rowan's camp at Francis Point, Beaverhills Lake. Here he met Munro and his wife, who took the taxi back. Rowan described Taverner's arrival in his field notes as follows:

> "Taverner turned up about 7 o'clock and Munro and his wife went back on the taxi. He (Taverner) brought his complete equipment with him, some load, but nothing on earth necessary for comfortable collecting appeared to have been forgotten. The tent has a ground cloth which hooks around the bottom and is practically mouse proof. It can also be made mosquito and fly proof; has windows, stove pipe exit, and a door at each end which are weather proof when closed. His collecting trays can be removed from their box and hung from the ridge pole in a fly proof cover. He brought various odds and ends with him including two Great Horned Owl skins, one of which is whiter than I have ever seen although bred down the Red Deer Valley." [75]

Robert Lister, who was one of the group, added

> "Rowan's own tent usually had a rope as a substitute for a ridge pole; the walls sagged; it attracted insects and ground squirrels gambolled through it at will."[76]

Thirty years later Rowan looked back on the event during a talk he gave in Calgary with the help of his field notes. He seemed, he told the audience, to have been filled with envy at Taverner's equipment, the first decent camping outfit that he had ever seen, and a great contrast to what he and Harrold were used to. Rowan mentioned that Taverner's equipment included bedstead and air mattress, adequate cooking utensils and that nothing was missing.

> "On the other hand, Harrold's bed and mine were merely blankets on the bare ground, whatever it might happen to be: our tent was borrowed, complete with two major leaks: our cooking outfit, a single frying pan and a coffee pot, the latter serving in turn for coffee, tea or stew as occasion demanded, with an erstwhile coal-oil container for drinking water which came out of the lake or the nearest slough. Taverner carried his with him: even his drinking water was respectable."[77]

Taverner gave *his* impressions of Rowan when writing to Ida:

> "He is the strangest little Englishman you ever saw – mercurially enthusiastic and too interested in shore birds to eat while they are present. In fact he and Harrold – due to this and economy — camp like Siwash rather than white people, and I was glad that I brought my equipment with me. When I left I donated a lot of my worn out equipment to their camp and added considerably to their comfort."[78]

Taverner spent several days there, then went to Edmonton to spend a weekend at Rowan's house. In the same letter he told Ida: "He has a very fine wife that is an admirable correction to his mercurial nature and four dear little children." From Edmonton he went to stay about a week with "good old Brooks" at Okanagan Landing.

In March 1925 Taverner and Anderson were involved in preparations for an expedition to climb, for the first time, to the summit of Mount Logan, the highest peak in Canada, and to measure, as accurately as possible, its height. The National Museum was asked to suggest a naturalist to accompany the expedition, and the name of H. M. Laing was put forward. By an agreement with the Alpine Club of Canada Laing was asked to accompany the expedition as naturalist and cinematographer. While he was training for this role Taverner sent him names of birds, some of which the museum particularly wanted to have evidence of as breeding in that region: Wandering Tattler; Surfbird; Sharp-tailed Grouse; Fox Sparrow and Timberline Sparrow [a race of Brewer's Sparrow, see note 60 above]. Ten mountaineer-scientists with the task of measuring the mountain, together with Laing, set off early in May, reaching the base camp at Trail End at the head of the Upper Chitina River, the limit of pack-horse travel where Laing remained for the next three months doing field work in the vicinity of the Chitina moraine. He returned with the climbing party in mid August by a partly new route. Six members of the climbing party reached the summit, and the height of the mountain was estimated to be 19 850 feet = 6050.28 metres. (Sixty-seven years later, in June 1992, a larger expedition carried out scientific work near the summit of Mount Logan and determined its height to be 5959 metres.)

When Taverner heard that Laing had arrived home in late August he went to join him at Comox and they had a great "talk-feast" which lasted a number of days. Since Laing was expected to write three

Beaverhill Lake, Alberta, August 1925. P. A. Taverner and C. G. Harrold. (Reproduced courtesy of the Canadian Museum of Nature, number 66835.)

reports on his field work and collecting, it was good that he could first have a talk with Taverner.[79]

For Taverner his field work for 1925 reached an enjoyable climax in his first visit to California. He spent a week studying the ornithological collections at the University of California, Berkeley, and Bishop's collection at Pasadena, Los Angeles where he saw interesting specimens. He also made a number of personal contacts that were likely to be of value to the museum. While at Pasadena he did some collecting including a jaeger. He returned to Ottawa by train via the Grand Canyon, Detroit and Toronto.[80]

At the New York meeting of the AOU in November 1925 Taverner and Anderson went, with Bishop's permission, to visit his series of gulls in his bird house at his home in New Haven, Connecticut. Writing to Bishop about the AOU meeting he noted the lessening influence of the Audubonites and explained,

> "So many of the old sentimental extremists have taken museum jobs and attained a better balanced view — Cleves and Harper for instance."

Bishop had a fine collection, just the kind of collection that they needed as a foundation for a National Museum.

> "I certainly wish that such a collection were available for work in cooperation with ours ... If we could only induce you to come to Canada it would be a National benefaction".[81]

It was a nice idea, but nothing more.

In addition to working on his book, field expeditions and keeping up a regular correspondence, Taverner still took an active part in the Ottawa Field-Naturalists' Club. Although he was not officially the editor of *The Canadian Field-Naturalist* in the 1920s he wrote regularly in its issues, gave his opinion on ornithological manuscripts submitted, and edited various contributions. For example, in a letter to Brooks he wrote of the problems that editors of the journal faced. Brooks had found bad errors in a list of western birds printed in the 1925 volume and wrote to Taverner complaining.[82] In reply Taverner stated the problem faced by editors who knew their own area very well but could not know all other localities in the same way. Unpaid editors were hard to find. The best way would be to send all B.C. material to Brooks for his approval but that would be impracticable.

> "I acknowledge my slip up especially in the Chipping Sparrow which I did not notice but if you saw all the stuff that I do question and eliminate you might be [less?] surprised at things that do get by. The editor of unpaid material has his hands full".

He suggested that readers should send the editor a note calling attention to mistakes which would make authors more cautious.[83] Another task he undertook was to write to Camsell, Deputy Minister of Mines, about supporting the application for a government grant of $1000.00 to *The Canadian Field-Naturalist.*

Camsell had promised to do so in conversation. Taverner now set down the reasons for asking for this grant. It is a strongly argued letter which shows how Taverner regarded the role of the journal. There were five affiliated Natural history Societies at this time, he told Camsell: Quebec; Ontario; Manitoba; Alberta and British Columbia.[84]

Sometimes Taverner led a bird walk in "south' Ottawa, for members of the Ottawa Field-Naturalists' Club. From where he lived on Leonard Avenue he could walk to Dow's Swamp which lay in a depression between Dow's Lake and the Rideau River (where part of Carlton University now stands). In the 1920s this area was a tangled swamp three miles from the town east of Bronson Avenue, and approached by Colonel By Drive. By using the C.P. Railway tracks it was possible to cross the Rideau River. Taverner could then walk eastward to Bank Street at Billings bridge and back to Leonard Avenue.[85]

With all Taverner's work obtaining information for *Birds of Western Canada*, and then writing it and reading proofs, much of his time in the years 1920-1926 must have been taken up. However, he found some time to write to his correspondents in provinces other than those of western Canada. The province of Quebec was not well represented among Taverner's correspondents although Harrison Lewis, Chief Federal Migratory Bird officer of Ontario and Quebec, kept him informed to some extent. There are a few letters preserved between William Brown and Taverner, and several between Henry Mousley and Taverner. In 1923 a new correspondent from Quebec wrote to him. This was Gustave Langelier, who was Superintendent of the Experimental Station for central Quebec, Department of Agriculture, at Cap Rouge, Quebec City. He said that Mr. Harkin had referred him to Taverner, and asked for help in identifying birds.[86] Thus began a correspondence which lasted until 1940. One of the birds that Taverner received was unusual for Quebec. When Taverner looked at the number on the collector's licence he found that it was in the name of Mme Bernadette Langelier. Taverner wrote direct to her congratulating her on collecting a Yellow-billed Cuckoo.[87] In reply Mr. Langelier explained that he and his wife had started a small collection in 1922. He also invited Taverner to stay at Cap Rouge as his guest. In October 1923 Taverner wrote to Langelier telling him that he had voted on his name as an Associate Member of the AOU. These annual meetings, Taverner explained, "are very enjoyable and more like a reunion of friends than the usual dry scientific meeting. It is astonishing what an active interest is growing in bird banding. Some of the results being obtained are of immense interest and importance."[88] Correspondence between the Langeliers and Taverner continued whenever they had birds they wanted identifying. By the end of 1924 they had over 500 mounted specimens in their collection. Meanwhile Mme Langelier was making a collection of skins and by December 1925 had made over 700. Some skins they exchanged with Bent, others they sent as far away as California and Alaska. Taverner was glad to hear of the progress they were making, and stressed that for study work skins were a necessity. He mailed them a copy of his "Instructions for Collectors", and said he would like to visit them and see their collection some time.[89]

One other ornithologist with whom Taverner kept up a steady correspondence was Arthur Cleveland Bent. Their letters were full of ornithological information and need to be read as complete letters in their proper sequence. Anyone doing so will see how much help Taverner gave Bent during the 1920s. Writing to Bent in 1922 Taverner said that he had a good deal of information at the museum but the problem was how to get it to him, so he invited Bent to come to Ottawa and see the information for himself. "I always have a room at your disposal and should be glad to act as your host."[90] Of course this correspondence was helpful to Taverner who was part of Bent's wide network of ornithologists. Taverner was kept informed of what ornithologists "on the other side of the line" were doing, particularly in taxonomy, even if he did not always agree with their findings. Bent asked Taverner to read sections of his *Life Histories* at this time. Writing in March 1922 he said, of a recent letter from Taverner, that it "impresses on my mind the fallibility of human nature and how difficult it is to try to avoid errors in a comprehensive work like mine."[91]

By early 1926 there was nothing more that Taverner needed to do for *The Birds of Western Canada* as it was being printed, so he left Ottawa in mid May on a field expedition to Belvedere, Alberta, about 60 miles north of Edmonton. He was joined there by Laing and Harrold. These three experienced observers studied two adjacent lakes — La Nonne and Majeau.[92] They left camp in mid-June for Beaverhills Lake where Rowan and a group of his helpers were preparing to band a large number of Franklin's Gulls. By 6 a.m. on 24 June thirteen birders went into the vegetation around the lake where the colony was nesting to start banding. The noise was deafening. By 9 a.m. the banders returned to camp for refreshments, and a rest, having used about 3000 of the 10 000 bands that Rowan had with him. By 10 a.m. they were at work again but by midday they could hardly stand up so they returned to camp. The total banded was a few hundred short of 5000. Taverner, Laing and Harrold stayed in camp for a second day to bring the total bands used to 5000. Whether this heroic effort was really wise is open to argument. At least it hit the headlines in *The Edmonton Journal*.[93]

While Taverner was in Alberta collecting and banding, the printing of *Birds of Western Canada* continued. Anderson wrote to Taverner in June with the reassuring news that the job was nearly finished. "Mr. Miles is on the job every day and is keeping the bureau up to the mark. There is only one more plate to run, and then he says they will send a bunch to the bindery, and the *magnum opus* will be out."[94]

During the early months of 1926 Taverner, with his inventive mind and nimble hands, was preparing several "stunts" for exhibiting during the AOU meeting in order to lighten a little the solemnness of the scientific papers.* One such "stunt" was making a small plaster auk, about 3 inches high, and inscribed "Ottawa 1926", copies of which could be made in a mould. One of these could be placed in each member's place at the banquet during the AOU meeting. In contrast Taverner projected another "stunt" which was to make a model of a Great Auk, of twice life size, for display. When the time came for the challenge of the AOU meeting Taverner was reasonably well prepared.[95]

*"Stunt" in the sense, not of circus stunts to thrill audiences, but rather in the sense of an act showing boldness of invention together with manual skill.

## CHAPTER 13. Meeting of the American Ornithologists' Union, Ottawa 1926

"For the first time in its history the American Ornithologists' Union met outside the United States and the forty-fourth stated meeting in Ottawa, Canada, in 1926, was a decided departure in several respects from any of its predecessors. Through the invitation extended by the Minister of Mines and Interior the meeting was made a semi-official affair and numerous courtesies were extended to visiting members by the Canadian Government. Special arrangements were made through the Immigration Department to facilitate crossing the border, the Museum where the meetings were held was made a temporary bonded warehouse thus permitting receipt and reshipment of exhibit material with a minimum of tariff restriction, and the general session was opened by an address of welcome by the Minister of Mines and Interior who also held a public reception for the members and attended the annual dinner."

T. S. Palmer, Secretary of the AOU[1]

Much effort went into the organization and day to day running of the meeting. The committee of the AOU in charge of local arrangements consisted of: P. A. Taverner, Chairman; Hoyes Lloyd, Secretary; R. M. Anderson. This committee kept in close contact with the Ottawa Field-Naturalists' Club Committee chaired by Clyde Patch, 1st Vice-President of the Ottawa Field-Naturalists' Club. This committee was appointed by the Club to deal with financial and other arrangements for entertaining the guests. It included representatives from various provinces across Canada.[2] Clyde Patch, as chairman of the committee, informed all Canadian members of the AOU early in 1926 of the arrangements, and encouraged them to be present. He also wrote to many other Canadians, requesting funds so that the local committee would be able to put on a really good meeting.

The meeting began on Monday 11 October 1926 with business sessions of the Council in the elegant banquet room of the Chateau Laurier hotel. A meeting of Fellows and Members was held there in the evening at which reports were given to provide those present with information on the state of the American Ornithologists' Union which appeared to be sound, judging by its membership which stood at one thousand eight hundred and fifteen. The following officers were elected for 1927: President, Alexander Wetmore; vice-presidents, Joseph Grinnell and J. H. Fleming; secretary, T. S. Palmer; treasurer, W. L. McAtee; Members of the Council: A.C. Bent, Ruthven Deane, E. H. Forbush, H. C. Oberholser, W. H. Osgood, C. W. Richmond and T. S. Roberts.[3] Taverner was on good terms with several of them and well known to all. The appointment of J. H. Fleming as a Vice-President was a step forward for Canadian representation in the running of the AOU. Also, from the list of Associates, two Canadians, W. H. Mousley and J. A. Munro, were elected members.

The general business included authorization to continue work on the "Ten Year Index of the Auk" and on the "Check-list of the North American Birds". Resolutions adopted included one opposing the general destruction of birds of prey which stated:

> "RESOLVED, That the American Ornithologists' Union deplores the present tendency to wantonly destroy birds of prey as more likely to result in ultimate economic loss than in gain; and also deplores the use of the word 'vermin' for these birds as tending to produce an unwarranted prejudice."[4]

The presentation of scientific papers occupied October 12, 13 and 14. These were held in the National Museum and were open to the public. "On entering the Museum on Tuesday morning members found on the landing of the main stairway, near the registration desk, a model of a Great Auk of heroic size, resting on three volumes of the Union: "The Auk", "The Code", and "The Check-list".[5] These were modeled by P. A. Taverner. On registering, each member was presented with a copy of Taverner's handsomely illustrated and finely printed work *Birds of Western Canada*, provided courtesy of the Canadian Government, as a souvenir of the occasion.

The general sessions were opened by the Hon. Charles Stewart, Minister of Mines and Interior. A total of fifty-seven papers were given ranging from a few of 45 minutes to many of ten or fifteen minutes. One of special interest to Canadian ornithologists must have been by Edward Preble of the Biological Survey, Washington D.C. on "Canadian Field Ornithology, 1750-1900". J. Dewey Soper, recently back after two winters in the arctic, made a brief report on his ornithological work in Baffin Island. Henry Mousley, of Montreal, spoke about his study of the home life of the Northern Parula [Warbler]; Frank Chapman gave an illustrated talk on "An Ornithological Reconnaissance in Venezuela"; F.C. Lincoln of the Biological Survey, Washington D.C. gave an illustrated talk on "The Migration of the North American Herring Gulls". Ernest Thompson Seton attended the meeting and spoke on two topics with intriguing titles: "Conservation Gone Mad" (15 min); "Bird songs enjoyed by other species" (with lantern slides); R.E. DeLury, of Ottawa, spoke on "Banding redpolls"; Clyde Todd spoke on "The 1926 Hudson Bay Expedition" and Prentiss Baldwin of the Baldwin Research Laboratory, Cleveland, Ohio, spoke on "The sport of bird banding". It would have been interesting to have heard how he defined bird banding as "a sport". [6]

While all this was in progress several exhibitions were on show. Preble's talk was supplemented by an exhibit of the more important publications on Canadian birds, illustrated by portraits of the authors which were loaned from the Ruthven Deane collection of photographs of members of the AOU.[7] Several exhibits of paintings, photographs and publications were installed in the halls of the museum. Of these the most important were the exhibits of bird paintings. The first formal exhibit of bird paintings at an AOU meeting was held at Washington in 1920. The catalogue of paintings and photographs at the Ottawa meeting included 444 entries representing approximately fifty artists. Thirteen artists showed photographs of birds. The exhibition contained several special displays in addition to the main one. A special one was the Robert Ridgway Exhibit containing drawings, manuscripts and letters illustrating his development as an ornithologist between 1850 and 1880.[8] Two special collections were devoted to bird paintings by Allan Brooks. One was of the illustrations made for Taverner's *Birds of Western Canada*, a total of 96 originals.[9] The other was a collection of 32 bird paintings commissioned by Wallace Havelock Robb.[10] Brooks was also represented by five water-colour paintings in the main exhibition.

Another special collection was loaned by the Emma Shearer Wood Library of Ornithology, McGill University Library, Montreal. This was mainly of water-colours by European artists in the nineteenth century.[11]

The names of other well-known bird artists of that time represented were: George Lodge; Robert Bruce Horsfall; Louis Agassiz Fuertes; Charles Livingston Bull; F.L. Jaques (4 scenes on the coast of Peru). Two artists who were to make their reputation later — George Miksch Sutton (4) and Roger Tory Peterson (2 in charcoal), also exhibited. Frank Hennessey, of Ottawa, showed four paintings in oils. Claude Johnson, of the National Museum, showed seven water-colours, five being of soft parts of birds, and an oil painting of a loon. Among those exhibiting photographs, Mousley of Montreal showed 5 of Marsh Hawks [Northern Harrier] and 3 of [American] Woodcock; Edward Warren of Colorado Springs, 6 of a White-tailed Ptarmigan, among others. Finally, P. A. Taverner's contribution was five photographs, field notes of colours of soft parts of birds (water-colour), and a statuette of a black Gyrfalcon. Those attending the AOU meeting certainly had plenty to interest them visually.

The social gatherings were more varied than usual and included a conversazione* on the first evening and the annual dinner the next evening. Informal receptions were held at the homes of R. M. Anderson, Harrison Lewis, Hoyes Lloyd, P. A. Taverner and George White on the Thursday evening which gave AOU members an opportunity to meet each other.

The conversazione was organized by the Ottawa Field-Naturalists' Club to entertain the visiting members of the AOU and was held in the museum on Tuesday evening. Hoyes Lloyd reported:

> "The guests were received by the Honourable Chas. Stewart, Minister of Mines, and Mrs. Stewart, Dr. Chas. Camsell, Deputy Minister of Mines, and Mrs. Camsell, Dr. W.H. Collins, Director of the Museum, and Mrs. Collins, and by Mr. C.L. Patch, 1st Vice-President of the Ottawa Field-Naturalists' Club, and Mrs. Patch. A feature of this entertainment, which appealed to the audience, was the demonstration of the cleaning of eider-down by Mr. Harrison Lewis. Motion pictures were shown by the Canadian National Parks. The evening closed with orchestral music and refreshments."[12]

T. S. Palmer reported on the films shown during the meeting:

> "The moving pictures covered a wide diversity of subjects and, including those shown at the conversazione, numbered more than twenty reels. The most remarkable were Gromme's unique views of [Common] Loons taken in Wisconsin and the scenes in the National Parks presented through the courtesy of the Canadian Parks Service. Lewis' pictures illustrated some of the economic phases of Eider Duck conservation, while Cordier's close ups of the Water Ouzel [American Dipper] revived the discussion regarding the nictitating membrane of this bird."[13]

*in normal meaning of the term: "a meeting of a partly social and partly scientific or artistic kind".


Canadian Group Photograph taken at the American Ornithologists Union 1926 Annual Stated Meeting, Ottawa, Ontario. Reading from the left to the right: 1. Charles Camsell, Deputy Minister of Mines, Ottawa, Canada; 2. J. A. Munro, Chief Federal Migratory Bird Officer for Western Provinces, Okanagan Landing, British Columbia; 3. Mrs. J. A. Munro, Okanagan Landing, British Columbia; 4. L. B. Potter, Eastend, Saskatchewan; 5. C. L. Broley, Winnipeg, Manitoba; 6. Mrs. C. L. Broley, Winnipeg, Manitoba; 7. Edwin Beaupre, Kingston, Ontario; 8. B. A. Fauvel, 321 McLeod Street, Ottawa, Ontario; 9. R. E. DeLury, 330 Fairmont Avenue, Ottawa, Ontario; 10. J. Dewey Soper, Victoria Memorial Museum, Ottawa, Canada; 11. W. E. Saunders, London, Ontario; 12. Dr. W. O. Malte, Chief Botanist, National Herbarium, Department of Mines, Ottawa, Canada; 13. Miss Edith Marsh, Peasemarsh Farm, Clarksburg, Ontario; 14. Harrison F. Lewis, Chief Federal Migratory Bird Officer for Ontario and Quebec, Ottawa, Canada; 15. Mrs. Harold Hibbert, Montreal, Quebec; 16. Mrs. J. A. Wilson, President, National Council of Women, Ottawa, Canada; 17. Mrs. R. M. Anderson, Ottawa, Canada; 18. Dr. R. M. Anderson, Chief, Division of Biology, Victoria Memorial Museum, Ottawa, Canada; 19. Mrs. A. B. Klugh, Kingston, Ontario; 20. A. B. Klugh, Kingston, Ontario; 21. Ernest Thompson Seton, Greenwich, Connecticut; 22. Reverend C. J. Young, Carring Place, Ontario (address until Easter); 23. Mrs. M. Y. L. Lafranchise, 31 Sherbrooke Avenue, Hull, Quebec; 24. Mrs. Hoyes Lloyd, 406 Queen Street, Ottawa, Ontario; 25. Hoyes Lloyd, Supervisor, Wild Life Protection, Canadian National Parks Branch, Department of the Interior, Ottawa, Canada; 26. J. H. Fleming, 267 Rusholme Road, Toronto, Ontario; 27. Miss P. M. McGahey, Canadian National Parks Branch, Ottawa, Canada; 28. Miss Ida Tavernier, Victoria Memorial Museum, Ottawa, Canada; 29. P. A. Taverner, Ornithologist, Victoria Memorial Museum, Ottawa, Canada; 30. W. H. Robb, Belleville, Ontario; 31. C. F. Haultain, Port Hope, Ontario; 32. Robert Owen Merriman, 96 West Second Street, Hamilton, Ontario; 33. Dr. H. G. Arnott, 18 Ontario Avenue, Hamilton, Ontario; 34. Miss Ida Merriman, 96 West Second Street, Hamilton, Ontario; 35. Napier Smith, Bank of Montreal, Verdun, P.Q.; 36. L. McI. Terrill, 44 Stanley Avenue, St. Lambert, Quebec; 37. Mrs. Louise Murphy, Montreal, Quebec; 38. Major Allan Brooks, Okanagan Landing, British Columbia; 39. Mrs. J. T. Hammill, Ottawa, Ontario; 40. Wilfred B. Alexander, Brisbane, Queensland, Australia; 41. Edward Arnold, Canadian National Railways, Montreal, Quebec; 42. Wm. Henry Mousley, 274 Girouard Avenue, Notre Dame de Grâce, Montreal, Quebec; 43. W. P. Young, Toronto, Ontario; 44. J. R. Dymond, Royal Ontario Museum of Zoology, Toronto, Ontario; 45. L. L. Synder, Royal Ontario Museum of Zoology, Toronto, Ontario; 46. C. L. Patch, Chief Taxidermist and Herpetologist, Victoria Memorial Museum, Ottawa, Canada; 47. Mrs. R. W. Tufts, Wolfville, Nova Scotia; 48. R. W. Tufts, Chief Federal Migratory Bird Officer for the Maritime Provinces, Wolfville, Nova Scotia.

As a record of the meeting two group photographs were taken, one of the entire membership, and the other of the Canadian members.[14]

The annual dinner at the Chateau Laurier Hotel was attended by about 180 guests. At each place at the tables a miniature of the Great Auk was to be found, a sign of Taverner's handiwork. After dinner the evening was given to entertainment. "Newsboys" distributed copies of the annual publication *The Auklet*, with its usual satirical parodies on recent AOU happenings, controversies and topical events, especially with a local flavour according to the city in which the current meeting was being held. Here are two items from the 1926 *Auklet*. One is from the section headed "Naturalists' guide to Ottawa":

> "Visitors wishing to see large flocks of ptarmigan should take the Bank Street car to the end of the line and walk four or five miles in any direction early in the morning. If no ptarmigan are seen, the visitor will realize that the excursion should have been made at an earlier hour."[15]

Another spoof centred round the problem of publishing any account of Canadian birds in *both* English and French. In *The Auklet* there was a note on the Wood Duck in parallel columns. The left column was headed "Histoire Naturelle Officielle Pour les Provinces". Under this was the statement "Bilingues redigee dans les deux langues par les professeurs de la faculte du college de St. Pingouinelle pour les Sourds-muets". The right column was headed "Official Natural History for the French Canadian Provinces". Under this it stated "Done Bilingually by Professors of the Faculty of the College of St. Aukie the Dumb". The title THE WOOD DUCK follows with a short column of nonsense on the species. The left side column, also nonsense, is headed LE CANARD HUPPE.* For the benefit of readers with a knowledge of French it is quoted in full.

> Il est aussi appele branchu et en anglais "Wood Duck" c.a.d. canard de bois, ce qui est la meme chose, car qu'est-ce que c'est que des branches sinon du bois. Cependant, son nom de huppee indique que c'est an aristo: n'a-t-il pas un sein de cuivre, et des pattes d'or?, n'est il pas tout ruisselant d'argent? Il est toutefois, toute du bois. Quelquefois appele la fiancee, mais le galant homme, naturellement, n'a pas une seule brassiere. C'est de lui sans doute qu'il s'agit dans la chanson:
> Le fils du roi s'en va chassant
> Avec son grand fusil d'argent et plus loin –
> Par ses yeux sortent des diamants
> Et par son bec l'or et l'argent." [16]

It was also acceptable to make fun of individual members, though gently, by exposing their foibles or enthusiasms. For example a Note in *The Auklet* said:

> "Members are urgently requested not to mention dahlias, irises or gladioli in the presence of W.E. Saunders during sessions as it is desired that he concentrate on birds during this meeting."[17]

A whole "genus" of members could be the subject of fun even when the claim was completely untrue, provided it was meant as a joke. For instance:

> "A feature of the meeting was the presentation to each registered guest of a copy of Taverner's 'Birds of Western Canada'. On taking these out of the country, the ungrateful Yankees, to a man, declared them for customs purposes as government reports of no value".

During the after dinner part of the program W. H. Robb of Belleville, Ontario, presented Allan Brooks with a gold medal in an eloquent address praising his work as a bird artist. This referred in particular to the thirty-two water colour pictures of Canadian birds on display, and called "The Wallace Havelock Robb collection". An explanation of this collection from the point of view of Brooks and Taverner, as shown in their correspondence, follows.

In the summer of 1923 Brooks had written to Taverner asking for his advice as follows.

> "What do you know about Wallace H. Robb? He has written me a long effusion telling me he is going to devote his life and poetry to the cause of bird protection 'after 1926', and demanding that I supply him with bird pictures for the honor of Canada at a reduced price. Is he one of those sloppy, slushy, anti-sportsman types?
> Please tell me so I can guide myself in my reply."[18]

In one paragraph of a letter to Brooks about various bird matters Taverner dismissed Robb as a sentimentalist as regards nature. He wrote:

> "Yes, I know all about Robb, he is a sentimentalist with a very exalted opinion of himself. Much ego in his cosmos. He is one of our thorns. Father is something very big in the G.T.R. [Grand Trunk Railway] and with the Government. He wants to turn the Naturalist into a Sunday-school leaflet affair with lots of 'pep'. Has an uncomfortable amount of influence and hurts our badly needed subscription list."[19]

Early in 1925 Brooks wrote to Taverner enclosing a letter he had received from Robb which drew a typical Taverner comment. Robb, he said, wanted to establish "a bigger and better and finer Bird-lore in Canada and run it in his own way. I think he likes jazz in bird literature. He is hopeless. I think it a case of more sail than ballast."[20] After the AOU meeting Robb wrote to Taverner sending the official copy of his address of presentation to Brooks, but complaining about the the derogatory style of the issue of *The Auklet* handed round at the dinner.[21] Taverner replied in such a way as not to hurt Robb's dignity but at the same time not to over praise him. After all, the paintings were by Brooks; Robb merely bought them. The paragraph that Taverner included on Brooks says something about Taverner's sense of values as well. It is reproduced here in full.

> "Dear Mr. Robb;
> All is fair prey to the 'Auklet.' Its main duty is to pick out all our pet foibles and hold them up to public derision. It is good for our souls and amusement and warning to our friends.
> Am glad to get the official copy of the address of presentation to Brooks. It made him squirm a bit for he

*posh, classy

greatly dislikes public praise though he is human enough to appreciate the appreciation of friends and after the presentation was over am sure that he was gratified at the recognition while the publicity was good for his soul as well.

Brooks is a very great man as well as an artist and ornithologist. He hates fuss or fullsome praise and is modest in the extreme. He has very high ideals and never compromises with them and he expects as much from his friends. He is very thorough in everything he does but has no patience with others who are less conscientious. A perfect gentleman and genial with those he likes he can hold off others with a polished urbanity that is impassable.

Your pictures have been taken down from the Art Gallery as the space was required for other material. The agreement was but for the week. I am holding them for your orders. The printed cards will be packed with them for your further use. Let me know where and when to send them. I think they were a great success. Their excellencies viewed them Monday and were much pleased with them.

Sincerely,
P. A. Taverner"[22]

On Friday morning about sixty people, led by Hoyes Lloyd and Clyde Patch, went on an excursion by motor bus to Kingsmere in the Gatineau Hills. On arrival the majority of the members walked to the top of King's Mountain to enjoy views of the autumn foliage from the summit. The remainder of the group visited the grounds of the summer home of the Right Honourable W. L. Mackenzie King, Prime Minister of Canada.[23] On the return of the main party to the foot of the hill an al fresco lunch was provided of hot dogs, rolls and coffee.[24] In the afternoon a party of eight left on foot for Ottawa, a matter of some 14 km, and reported seeing eighteen species of birds. The main group walked by a pleasant route to the village of Chelsea where they were met by bus for the return trip to Ottawa. The highlight of the outing was the fall colours which were at their peak in mid-October.

During the weekend of 16-17 October thirty-nine people went on an excursion to Blue Sea Lake. They travelled northward along the Gatineau River by a single track railroad to Messines, in the province of Quebec. From there they were transported by boats to Big Island in the lake. The members were billeted in cottages belonging to the Andersons, Taverners, Patches and Miss Maude Scott.[25] Taverner referred to the excursion in his racy way in several letters to friends who had not come to the AOU meeting. Writing to Laing he noted:

"Were some crowded but all good natured and happy. It was quite an experience to stroll along the trails of the island and meet famous ornithologists at every other turn".[26]

Writing to Ernest Thompson Seton he said

"Our good luck and good weather held out over the weekend, and about 35 people went on the Blue Sea Lake excursion. They saw Bald Eagle, Surf Scoter, Hooded Merganser, [American] Pipits, Three-toed Woodpecker etc. and went home happy, as far as we could judge."[27]

With the return of the Blue Sea Lake contingent to Ottawa the 44th meeting of the AOU came to an end. Secretary T. S. Palmer concluded his report of the meeting for *The Auk* with an analysis of its attendance. A few facts presented by Palmer may still be of interest today. A total of 135 members attended the Ottawa meeting. Among these were: one of the original Founders, Charles F. Batchelder, and three Fellows elected at the first meeting: Ruthven Deane, Jonathan Dwight and W. E. Saunders. One corresponding Fellow from Australia, W. B. Alexander, attended. Fourteen natural history museums were represented by one or more of their members. Here followed the names of 22 Fellows (and one corresponding) and the 24 members present. The names of Associates were due to be published in the annual Directory of Members in *The Auk* for April 1927.[28]

Taverner, since he played a major part in organizing the meeting and provided much of the high spirited fun ("stunts") will be given a chance to sum up the proceedings by quoting from his letters to several friends. To Mack Laing he wrote:

"The great Meeting is over and all declare it was one of the most successful ones ever held. I know we put over some stunts that have never been attempted before and everything went without a hitch. I only heard two short papers read but had the time of my young life in spite of that. The Exhibition is certainly the best the A.O.U. ever held. Conditions of display were not ideal as our facilities for hanging were limited but we had a broader representation than ever before,- Millais and Lodge and Wolf and Gronvold were represented from England and Larsen and Lillejefors from the Continent besides a quaint and historical collection from all over the world from the Casey Wood collection at McGill.

The conversazione was quite a brilliant affair. The Minister of Mines and the Interior and his lady received and we had real music and dancing something the A.O.U. never saw before. On the landing of the main stairs we had a great big Auk modeled in plaster sitting on a pile of volumes representing the Auk, the Code of Nomenclature and the Check List, this was surrounded with palms and backed with a trophy of British, French and American flags. Also a smaller Auklet standing on the work and scolding was a secondary feature here. These aroused considerable interest and approval. We served luncheon daily in the museum with the aid of the ladies of one of the churches not a commercial caterer."[29]

What made the greatest hit, Taverner said, was to present every bona fide registrant with a copy of *Birds of Western Canada*.

Another of Taverner's friends was unable to come to the meeting — William Rowan. This was especially unfortunate because Rowan was one of the very few professionally trained zoologists working in Canada at this time, and the only one with a growing reputation based on scientific research. His presence at the meeting would have interested a number of the ornithologists from the U.S., as well as being

of considerable value to Rowan himself. It was ironic that one of Canada's foremost ornithologists was unable to attend the first Canadian meeting of the AOU. This was partly because of his teaching commitments at the University of Alberta. He expressed his feelings in a letter to Fleming when he wrote, "Nothing that has ever happened has been so disappointing to me as to have to stay in Edmonton whilst the AOU is meeting in Ottawa."[30]

Taverner, also, was very sorry that Rowan could not attend the AOU meeting and said so in a letter to him:

> "Of course was very sorry that you could not be here to enjoy all the fun and profit of the A.O.U. meeting but as we did not expect you was not disappointed. The whole affair went off very well and in a manner that was a credit to Canada and the Canadian A.O.U.s … I object to your applying the name 'Yankee Pie' to the A.O.U. That Yankees outnumber Canadians in its ranks of all classes is but natural considering the relative size of the source of the two divisions. No such body could be less narrow than they are. That most of the leading ornithologists hail from the other side is because we have not raised them but they recognize talent from over here as quickly as from there. I don't like this subtle innuendo back and forth across the line, — it is a sign of inferiority complex and provincialism."[31]

To Louis Bishop, who also could not attend the meeting, Taverner wrote a long letter, beginning with two lines from Rudyard Kipling's poem, *Recessional* (verse 2), presumably for dramatic effect.

> "Dear Bishop:
> The tumult and the shouting dies,
> The captains and the kings depart
> and I am trying to settle down to the hum drum routine again with but indifferent success. Entertaining an A.O.U. meeting is rather heady business, — but a barrel of fun. All you mentioned were here and lots more, in fact we had a large meeting in point of numbers and many were good enough to say that it was the best meeting ever, — but the last one is always that any way."[32]

Most of his letter was taken up with ornithological questions raised at the AOU meeting. Taverner had been working for a considerable time on a study of the Red-tailed Hawk, including two forms recognized in the Check-list; Krider's and Harlan's Hawks. When Swarth read his paper at the meeting on "Evidence of the systematic status of the Harlan Hawk" Taverner told Bishop "I was forced to take issue with him." Even after the talk, when Taverner showed his specimens of Harlan's Hawks, Swarth showed little or no interest in them.

Although Taverner was displeased by Swarth's paper on Harlan's Hawk he had no need to worry about the reception that *Birds of Western* Canada would receive from reviewers. What criticisms that reviews contained were relatively minor compared with the praise with which it was welcomed. In his review in *The Condor* Swarth explained that the book was designed as a popular manual, to give information to an intelligent public, but one knowing little of the technicalities of ornithology. "This purpose in the main has been excellently carried out …" However, as Taverner explained in his introduction, the scientific name used was always binomial, while subspecies were not given a formal title and, if mentioned, received only a subordinate paragraph at the end of the entry for each species. Swarth then gave an example:

> "As examples of questionable treatment, the author's adherence to the rulings of the A.O.U. Committee on nomenclature obliges him to lump under single heads such widely diverse birds as the Slate-colored and Oregon Juncos [Dark-eyed Juncos], the several White-crowned Sparrows, and the equally diverse subspecies of Fox Sparrows and of Song Sparrows."

Swarth argued that individual scientists may regard "degree of difference" as a criterion for the separation of species but the lay observer who turns to a popular manual for information will be puzzled. Some of us, he said, who believe that the Juncos mentioned "*are* two distinct species, will sympathize with him". Having made his point, Swarth continued:

> "However, I am by no means inclined to quarrel with the author in his manner of meeting the difficulties of nomenclature; quite the contrary, for in such a publication as this subspecies should unquestionably be accorded a very subordinate position. Mr. Taverner may in fact, in this instance, ride his own particular hobby with little danger of colliding with any one. If he is in fault at all in the details mentioned — a debatable question — it lies in his attempt to follow consistently the rulings of some one accepted authority."

Swarth praised the large number of coloured plates, mostly by Allan Brooks.

> "The artist's skill has brought out the salient points to be emphasized, and as the engraver, too, has done his work well, these illustrations are all that could be desired."

Swarth concluded his review by praising the volume as a whole.

> "Too much can not be said in praise of a governmental policy that places a volume like this within reach of every one interested in the subject. It is a book for practical use, and it is also a beautiful volume, to be cherished in any library."[33]

Witmer Stone, past president of the AOU, reviewed the book in *The Auk*. After mentioning the many line cuts of heads, feet, wings etc. by Taverner, and very useful silhouettes of hawks and other birds of the air as they appeared from below, and the coloured plates, Stone wrote:

> "Mr. Taverner is to be congratulated upon doing for west Canada what he had already done for the eastern provinces and doing it still better. The work will enable western students to familiarize themselves with the bird life of their region and will result in the development of many an ornithologist for the future …
>
> Mr. Taverner, as in his previous works, strives to suppress the subspecies as much as possible and we find in the brief mention of the subspecies which is appended to the account of the species, again and again such state-

A professionally taken portrait of Percy Taverner framed with the words "Sincerely P. A. Taverner taken about 1927". Percy had recently discovered that a Mrs. Fowler was living in Los Angeles. She was an elderly widow of someone named Fowler who might turn out to be Percy's deceased father, hence the gift of his photograph to Mrs. Fowler. (National Archives of Canada, Accession number 1984-178 Hoyes Lloyd collection.)

ments as: 'the distinction between the two forms is too fine for general recognition' or 'the differences are so slight as to be of little popular interest.' We quite agree with the advisibility of supressing the subspecies in such a work as Mr. Taverner has written, in the majority of cases, because as he says they are too finely drawn to concern the general public. But we must not lose sight of the fact that subspecies are not based upon degree of difference but upon the criterion of intergradation and that there are many subspecies quite as distinct as many species. Indeed some of the subspecies of Song Sparrows are far more easily distinguished than are the small Flycatchers to which full recognition is accorded."[34]

Finally, the book received a good endorsement from Taverner's colleague in the zoology division at the museum. Writing to a cousin in the U.S. in 1927 Anderson mentioned the publication of *Birds of Western Canada*, and said that for any young friends

"who want to get a good illustrated bird book at a bargain, this is a very useful one, as it includes all birds from the Ontario border to the Pacific Coast. It is a large book, sold post paid for 75 cents in paper covers, and \$1.25 in cloth."

He also said that the museum had received "any number of orders from U.S.A. Teachers and schools take a large number."[35]

*Family Affairs*

During the years 1925 and 1926 Taverner had been working hard on field studies, and writing and re-writing versions of his book while enjoying little recreation and no holidays. It is not surprising that he did not undertake a collecting expedition in 1927, but instead went to California to see his ornithological friends there, and the birds of that region. He told a few friends that he was also going "for family reasons", and would have to stay "with an elderly relative in Los Angeles". How did Percy find the address of this relative at this time in his life? He did not seem to have mentioned a relative of either his mother or his father in correspondence that has survived. Since Percy kept very few private letters, and certainly not a single one about his father, we have to follow up any clues that happen to appear. Presumably his mother had lost track of her first husband after her marriage to Albert Tavernier in 1881. We know nothing of what she told Percy about his father, but most likely it was a closed book between them. Certainly they were both too busy to waste time raking over the past. But, after his mother's death in 1924, Percy thought about the hardships of her early life, which he mentioned in a letter to Brooks.[36] Perhaps he also thought about his own "lost" father, Edwin Fowler. However, nothing could be done by Percy himself until someone else made a move.

While on a collecting expedition along the Red Deer River with Harrold in 1925, Percy received, like a bolt from the blue, a piece of information which he passed on to his sister. He wrote:

"Got a strange and unexpected letter the other day from a man in Oak Lake, Man., asking if I were the infant he knew in Guelph 50 years ago. Asking me to visit him as I passed homeward. I do not know him but he seems to know all about me. Strange, isn't it?"[37]

Tantalizingly Percy did not give the man's name in his letter to Ida but presumably he showed it to her on his return home. There is no indication that he called on this stranger, although Oak Lake is only about thirty miles from Brandon which was on the Canadian Pacific Railway. It would have been easier to correspond with him. All we know is that by early 1927 Taverner was in touch with a Mrs. Fowler, living in Los Angeles. Writing to Munro about various conservation matters he casually mentioned that he and his sister were taking a trip west in the summer.

"She has never been west and I have to go down to Los Angeles on personal business, so she has decided to accompany me".[38]

When Bishop heard from Taverner that he was intending to come to Los Angeles in the fall of 1927 Bishop invited him to stay. Taverner thanked him but explained that he would have to spend much of his time with an old lady relative "whom I have just discovered [living] in Los Angeles."[39] Writing to Fleming in August he mentioned that he was planning to leave for California shortly, and explained the reason.

"I have to go down to Los Angeles on personal business. Was going to do it next winter but it seems better not to wait. There is an old lady down there over 80 who is likely to go any moment and it is important that I see her. It is a rather strange story and some day I may tell you about it."[40]

Confirming arrangements for their visit in a letter to Bishop of August he said that Ida would be coming with him, and that they would both have to stop with Mrs. Fowler, at 920 Gramercy Drive, Pasadena.[41]

Percy and Ida had an enjoyable trip wherever they went, with all kinds of courtesies extended to them. They stayed four days with the Munros at Okanagan Landing, and spent time with Brooks and his wife. In Victoria they spent one day sight seeing, including a visit to the Butchart Gardens. Taverner, as a keen gardener, considered these wonderful and wrote: "There is nothing like them even in California. Victoria is certainly the place in America to grow flowers."[42] In San Francisco he visited Swarth at the California Academy of Sciences, and Grinnell at the Museum of Zoology, University of California, Berkeley. With Ida he spent two days in Yosemite National Park sight-seeing, and they decided that it was the loveliest spot they had ever seen. In Los Angeles he spent an evening with Bishop and six of his friends. As he told it to Fleming "it was quite a little bird party". On the way home they spent a day at Tucson. An ornithologist friend of Swarth, Joseph Mailliard, took them for a motor trip through the desert. Here they saw the unfamiliar forms of the

large cactuses — Great, Barrel, Choya [Cholla] and Opuntia, as well as the wonderful coloration of the desert. Among the birds they saw were [Greater] Roadrunner, Vermilion Flycatcher, and a great number of Swainson's Hawks migrating.[43]

It had been an enjoyable month's holiday, travelling and visiting friends, for both Ida and Percy. Perhaps the most exciting event was the visit with Mrs. Fowler. At last Percy was able to ask someone who had been married to his father in more recent times all the questions that had been puzzling him during the past two years. But although Percy and Ida now knew, and although Percy may have told Fleming some things about his father, he left nothing on paper that tells us anything more than where Mrs. Fowler was living.[44]

While Percy's mother was alive there is no reference that I have been able to find in any surviving correspondence to any woman friend, or of Percy having wanted to get married. After Mrs. Taverner's death, Will Saunders, writing to Fleming to say that he had heard of the event, added, in his Puckish sense of humour, "It is too bad as it may compel Percy to get married which he does not want I suppose".[45] It is not clear why Saunders should have made this supposition. Certainly at that period in Taverner's correspondence with his closest unmarried friends there was a certain amount of teasing. When men wrote to one another about having an affair, or preparing to get married, they were likely to use jocular phrases and jargon that covered over the seriousness of the subject. While Laing was having a long drawn out affair with his fiancee Ethel, from 1920 through 1926, he had to put up with some chaffing from Taverner who claimed that he was saving up for the happy day when Mack and Ethel would finally be married.

Brooks was the first of the bachelor friends to get married, in April 1926, to Marjorie Holmes of Arundel, England. Laing wrote to Taverner, giving him the news, and added, "Well you're next. I couldn't think of beating you to it. They will forget about me for a while."[46] After the AOU meeting Taverner wanted Brooks to stay a few days longer and look over some birds, but Brooks was too anxious to return to his wife to stay. Writing to Laing Taverner remarked, "Who would have thought that Brooks would ever side step birds for a woman? Wonders never cease. There are still greater wonders to come." At last Mack and Ethel were married in January 1927. The next to get married was Soper, in the spring of 1927. Writing to Fleming this is how Taverner described the wedding.

> "Soper's wedding went off very nicely. The lady came on a week ahead and stayed with us as she had no friends here at all. The wedding was at our house also and a pretty ceremony it was. Just about the prettiest bride I ever saw. Dewey was proud as Punch of course. He is some fast worker. Met the girl when he went back to Edmonton after the A.O.U. and had her in three days, stayed three days more with her and arranged for her to come on here to be married after six days aquaintance, — and seems to have made an admirable choice too."[47]

In a letter to Munro of February 1927 Taverner commented on Brooks and Laing getting married. In a P.S. he added: "Soper gets married March 14th at our house to a western girl. He did it all in six days, — some worker that boy." But he warned Munro "Don't expect me to walk the plank yet at any rate. However, I seem to be the sole survivor."[48] It was now Taverner's turn to put up with some funmaking by his friends. In a letter to Laing about a mix up over arrangements for Laing's field work for the summer of 1927 he added: "Yes all the world seems marrying mad. All friends and neighbours have had me married or about to be so this winter. It was certainly a flattering report but it has caused more amusement than trouble."[49] Although Taverner continued his correspondence with his old friends with the same zest, sometimes he overdid the joke about marrying a wife and having the services of a stenographer. In a letter to Laing of May 1928 he became quite eloquent on the subject. Whether Laing took it in the spirit of of light hearted banter one cannot say. But his conclusion may have had more than a grain of seriousness when he wrote:

> "P.S. The most interesting thing about your recent information is your wife. A typing, bird-skinning, camping and good cooking wife is a pearl without price, — are there any more at home like her? I am interested."

Did Taverner realize what he was missing more than he was prepared to admit?[50]

While Percy's friends were getting married he was not left entirely "in the cold". What eventually linked both Percy and Ida to a partner was, to some extent, their cottage, Hyla, on Blue Sea Lake. When their mother's health was declining a friend of long standing from Detroit, Martha Wiest, came to spend her summer holiday at Hyla. Martha was a widow who taught music at a private girls' school in Detroit. Each year after 1924 she and her son, Karel, came to Blue Sea Lake for their summer holiday. This was convenient for Percy and Ida since neither was at the cottage much in the summers of 1925 and 1926. By this time Percy had come to realize that the amount of entertaining that Ida was required to do while sharing with him their home at 45 Leonard Avenue was considerable. Although they had a good housekeeper, the strain of entertaining the guests during the AOU meeting, and working as a librarian at the museum as well, could not be glossed over. Percy was hospitable by nature and enjoyed entertaining ornithological friends and acquaintances from across Canada, and from the United States. Letters of thanks from guests in this period continually referred to their hospitality and kindness, but the amount of entertaining Ida had to perform was onerous. In June 1929 Ida had her birthday party at Hyla,

one of the guests being John McLeish, director of the Mines Branch of the Geological Survey.[51] From the guest book kept at Hyla we know that John McLeish first spent a weekend at the cottage in May 1927. From that time he was a guest there from time to time, and there are a number of photographs of him with Ida.

There is no information in letters which have survived about the events leading to Percy's and to Ida's marriages in 1930, but their close friends in Ottawa, especially visitors to the cottage, must have realized what was "in the wind". The only person whom Percy told ahead of the announcement of his forthcoming marriage was Fleming. Taverner must have asked Fleming for advice on a hotel in Washington for his honeymoon, because Fleming replied that the Burlington was the most comfortable. Writing to Fleming on 7 March Taverner said,

> "I escaped any dire results in Detroit. The ring was a great success and the lady was delighted with it. Everything is fixed and I expect that [on] the 29th my bachelorhood will be smashed irrevocably."

In the next sentence he went straight into bird news when he wrote,

> "one day in the school grounds there saw a [Northern] Cardinal whistling in great shape. Was a pleasing sound that I have not heard since 1913 at Pt. Pelee."[52]

This must have been in the grounds of the Liggett School, Detroit, where Martha taught piano from 1923 until early 1930. The school newspaper, the *Gopher*, under "Society Notes", told the news of her marriage.

> "Friday, the last day of school before spring vacation, an exciting bit of news was quickly spreading. Not only exciting, but romantic! Mrs. Wiest, that perfect attendant, who firmly believes that no cold should keep you from school, or that you should ever have one, was absent! This, however, did not cause as much comment as the whispers of certain people-that-should-know to the effect that she was getting married! We couldn't learn much about him, not even his name, but it was said that he was connected with a museum and had a Van Dyke beard. A few days later we nodded wisely as we saw in the paper that our own Mrs. Wiest, had, on Saturday, March 29 married Mr. Percy A. Taverner of Ottawa, Canada."[53]

Percy sent news of his impending marriage in a letter to Munro. He asked:

> "Did you know that Ida is going to be married? For that matter so am I but don't let the cat out of the bag ... until at least the first of April, — after that it will be all over. Yes, I think I deserve congratulations. Hope I can do as well as Brooks did."[54]

Munro passed the news to Laing who wrote in a jocular way:

> "Dear P.A.T.:
> I guess I'll have to believe it but its ____ hard. Very hard. For a case-hardened old sinner so d- glad he was single and not as other men are, on Dec. 9th last, you sure have suffered a change of heart — quite a transformation in fact."

Laing ended the letter in the same humorous way as follows:

> "Well any how I hope you will be as happy as I am and though of course your ornithological career is ruined I congratulate you on showing that after all you are human and here's our best wishes for happiness and good luck to you and yours."[55]

The wedding took place at Taverner's house. The invitation card was quite different from the usual printed one. It was designed and printed by Percy himself. It said in part:

Martha Hohly Wiest — Percy A. Taverner
United March 29, 1930
At their Home in Ottawa

It was elaborately decorated with symbolic themes — a thrush singing, a man with a winged helmet riding a horse among the clouds, a castle, a hill and a lake. Also some bars of music which later Laing deciphered as the "Ode to Joy" theme from Beethoven's Ninth Symphony. Perhaps Percy arranged to play that theme on the gramaphone since he had a recording of it. It would have been just like him to have pulled off such a "stunt" — at his own wedding. The bride was fifty years old, the bridegroom was fifty four. They had known each other since 1904.[56]

They spent their honeymoon in Washington and Charleston.[57]

## CHAPTER 14. Strains at the Centre: Percy Taverner and Dr. Anderson

After Taverner had assumed his duties at the Victoria Memorial Museum in May 1911 he began to assess the collection of birds which the Geological Survey had been storing in its buildings. He soon discovered that it was hardly one to be proud of. The first thing that needed doing was to catalogue them, a major undertaking, in which Taverner was aided by Frank C. Hennessey, re-labelling specimens, verifying data and tracing the history of the accessions. Although a student, Hennessey had recently returned from an expedition into the Arctic as assistant naturalist and artist under Captain Joseph-Elzear Bernier. The reason for this voyage requires explaining.

During the nineteenth century the British Navy and the Hudson Bay Company served to substantiate Britain's claim to the Arctic archipelago. Canada's claim to the Arctic islands dates from 1880, but her concerns over American activities there began earlier in the century. This was the main reason for the transfer of the archipelago from Britain to Canada in 1880.[1] Geological mapping, mineral exploration and exploitation came first, but from the 1880s the threa

to Canada's claims to sovereignty over the Arctic islands had become clear. The Canadian government began sending expeditions to show the flag, and to stake a claim to territories not acknowledged by other countries as being under Canadian sovereignty. One way to do this was for the Dominion government to establish permanent police posts, and to resupply them by regular "Arctic patrol" voyages each summer. Another way was by sending an official expedition that might last a year or more and during which a cairn would be built or a plaque erected. The *Neptune* expedition of 1903-1904 commanded by A. P. Low of the Geological Survey of Canada was sent to assert sovereignty over Hudson Bay and the east Arctic, including a claim to Ellesmere Island.[2] Captain Bernier made several voyages in government service, the most important being that of 1908-1909, when he overwintered at Winter Harbour on Melville Island. Here he set up a plaque claiming the Arctic Archipelago for Canada from the mainland to the North Pole.[3]

By 1912 Taverner realized that the museum's collection was well represented by birds found from southern British Columbia to southern Manitoba. Unfortunately most of the "northern" material collected by G. M. Dawson, R. Bell and others had disappeared.[4] Taverner determined to build a collection of Arctic and subarctic specimens, and whenever possible bought from those returning from Arctic regions. Thus when Captain Bernier, who had been in the Arctic since 1916, returned to Ottawa in 1920, bringing with him specimens of birds collected mainly at the southeast corner of Victoria Land [Island] he sent them to the museum. Taverner, writing to Fleming, listed the most desirable specimens. These were: [Red] Knot, including downy young in several stages, also eggs; White-rumped Sandpiper with downy young; Black-bellied Plover with half-grown young; white and gray Gyrfalcon; Rock and Willow Ptarmigan, both with downy young; Sabine's Gull adult, and half-grown young.[5] Taverner also wrote to Bent on the same topic telling him that the museum wanted to purchase a lot of them, and asking him to give his opinion on the value of the most desirable ones.[6] (Bent had very recently written to Taverner asking him for data to be used in Volume I of his *Life Histories* in making up the egg dates for each species. Previously Taverner had sent him dates for sets of eggs in the museum's collection of ducks, geese and swans for numbers 1 through 143. Now he wanted data on the remainder, showing locality and date for each set.) Bent and Taverner could give each other valuable help in ornithological matters.[7]

By far the best opportunity for the museum to expand its small collection of arctic birds happened during the Canadian Arctic Expedition of 1913-1916, and the appointment of R. M. Anderson as zoologist to the Geological Survey of Canada. After the expedition he was appointed to the Division of Biology at the museum in Ottawa where he worked until his retirement in 1946. As a result Taverner and Anderson worked in close proximity at the museum until Taverner's retirement in 1942. They interacted on each other continuously during those years, though their family backgrounds, upbringing, education , and experiences before each joined the museum could hardly have been more different. With this in mind it may be useful to give a brief "flash back" to Anderson's background until he and Taverner met at the museum in late 1916.

Rudolph Martin Anderson was born in Winneshiek County, Iowa, on 30 June, 1876, of Swedish and Norwegian descent. He attended public schools and high school, graduating in 1894, entered the State University of Iowa, where he obtained a B.Ph. in 1903 and a Ph.D. in 1906. During these years he specialized in systematic zoology, comparative anatomy and animal morphology, while working his way through six years of university study as an Assistant Curator in the University Museum, and an assistant in the zoology department. During military training he served for five years in the University battalion, and in the National Guard of Iowa Infantry for six years. In athletics he was captain of the university track team and set two records that were unbroken for a number of years.[8]

His interest in birds started early, and from 1893 he was publishing short papers on several species. At the age of twenty-one he produced a list of birds of two counties in Iowa, which was privately printed (1897), followed by his well-received book *The Birds of Iowa* which was in part fulfillment for his Ph.D. degree. This was a solid achievement based partly on his own observations, partly on information from a large number of contributors, and partly on writings such as Paul Bartsch "The Literature of Iowa Birds" (1899).[9] His book was reviewed by J. A. Allen, Curator of Birds and Mammals at the American Museum of Natural History, in *The Auk* 1907; by F. M. Chapman in *Bird-Lore* in 1907; and by Joseph Grinnell in The *Condor* 1908, who said that it was the best State list to have come to his notice. "It has the stamp of scholarly workmanship. Iowa ornithologists are to be congratulated upon so satisfactory an exposition of their avifauna." The author's own annotations were extensive.

While Anderson's book was being published and reviewed, Taverner and Swales' ornithological research on "The Birds of Point Pelee" began publication in *The Wilson Bulletin* in 1907.[10]

In the first three chapters of this book we have seen what a poor start in life Percy Taverner received, in particular because he had no father of his own, nor any grandparents from his father's or mother's family. Nor did he have any brothers or sisters (except his half-sister, Ida Clare), nor any cousins. This prevent-

ed him having the morale that a young boy with a full quota of parents, grandparents and close relatives would normally have had at that time.

By comparison Rudolph Anderson's life was supported by two families. His father was a Swedish born graduate of Iowa University, and a member of the Iowa Legislature. His mother was a daughter of Nelson Johnson who immigrated from Norway, eventually becoming a pastor and farmer in Iowa. Several Anderson and Johnson uncles were of some prominence in their states. In 1913 Rudolph married Mae Belle Allstrand of Swedish descent, who had a B.A. (Iowa) and later an M.A. from Wisconsin.

Percy Taverner knew nothing of his paternal grandparents, and had only the vaguest recollections of his father, if any. He never knew his maternal grandparents. He had no uncles or aunts, nor any cousins. He had no wife until later in life. He left no "family papers" when he died.

By the time Anderson graduated with a Doctorate in 1906 he had already displayed a great deal of promise. Compared with Taverner, at the same age, he was in a different world of achievement. In 1906 he became assistant Commandant at Blees Military Academy, Macon, Missouri. Here he had little time for field zoology and museum work, both of which he found satisfying. However, he soon had the chance to make a turn in direction, a change which influenced his whole future career.

While at the State University of Iowa in 1902 Anderson had made the acquaintance of a student, born in Manitoba of Icelandic parents, Vilhjalmur Stefansson, who moved to Harvard University the following year. When Anderson read about Stefansson's plans to make an expedition to the arctic he wrote about joining him. An agreement was made, with Anderson being hired by the American Museum of Natural History as a field agent for zoological collecting.[11] After the "Stefansson - Anderson Expedition" of 1908-1912 returned to the United States Stefansson began organizing a major expedition into the arctic, this time by ship. When the financial support promised by the National Geographic Society of Washington and the American Museum of Natural History was insufficient to support an arctic expedition on the scale desired by Stefansson, he turned to Reginald Brock, Director of the Geological Survey of Canada, which had given some limited support to the previous expedition. Brock secured him an interview with the Canadian Prime Minister, Robert Borden.[12]

The expedition was divided into a northern party under Stefansson, and a southern party under Anderson, with Stefansson in command of the expedition as a whole. The scientific work of the expedition relating to geology, geography, anthropology and biology was to be under the direction of the Geological Survey. Anderson was responsible for the work of mammalogy and ornithology. As a result of this organization Anderson, and the scientific staff of the southern party, should report to the Geological Survey. But Stefansson had final authority over the division of the ships, so that in an emergency he might challenge Anderson's powers over the southern party.[13] One further problem was to cause ill feeling within the organization of the expedition. The department of Naval Service was to have "general direction" over the other departments of government in the expedition, including the Geological Survey, which was a branch of the department of Mines. During the expedition the scientists of the Geological Survey acted as a group, making Anderson's position as leader of the southern party extremely difficult and Stefansson's position even more awkward, as the showdown at Collinson Point camp, in March 1914, showed.[14] Anderson was to feel the scars of this episode long after members of the expedition had returned to Canada.

With this introduction of Anderson to the Canadian Arctic Expedition we can now return to Taverner at the National Museum in Ottawa. By February 1913 Taverner had heard that Anderson was going on the Arctic Expedition with Stefansson, and that J. A. Allen had recommended him highly as zoologist and mammalogist.[15] Taverner wrote to Brock calling his attention to this. In a letter to Fleming Taverner said that it would be great if Anderson could be given some museum appointment for the coming trip,

> "and perhaps land him here as part of our staff when he returns. Am in hopes that we can give him some sort of honorary appointment on the staff to be confirmed on his return so that he can collect for us and at the same time receive salary from the exploration fund."[16]

Anderson and Taverner did not meet while preparations were being made for the expedition to leave from the west coast of Canada in June 1913. Taverner wrote to him in 1914 at Bernard Harbour in Dolphin and Union Strait, where the southern party had its headquarters since August 1914, which reached Anderson in November after his return from a trip up the Coppermine River. Anderson replied with a letter dated 10 January 1915, from Bernard Harbour, giving news of his party, and his collecting zoological specimens.

Anderson had sent a report on collecting done by the southern party during the first year 1913-1914 (from July to July) amounting to 212 birds and 77 mammal skins.[17] Now, in his letter of 10 January 1915, he reported good specimens of Barren Ground bears, and where they came from. Birds were not numerous, though he took about 12 specimens of Yellow-billed Loon, and some Black-throated Loon [Pacific Loon], and 2 Red-throated Loons which were rather scarce in the region of Dolphin and Union Strait. The only species of eider duck there,

he said, were Pacific [form of Common], and King Eider. He watched a nest of Semipalmated Plover "from the time the eggs were laid until the young hatched, and got some good pictures of eggs and downy young as well as the parents." The only common shore birds, he reported, were Baird's Sandpiper.

Anderson told Taverner that he intended to stay permanently with the Survey if conditions were favorable for scientific work at the museum.

> "Next summer will be my ninth summer in the arctic, and I have quite a bunch of notes which I ought to work up."

He ended his letter "I am yours sincerely / Rudolph Martin Anderson."[18]

Anderson and the southern party returned to Victoria in September 1916.[19] This brought Taverner a lot of extra work preparing for Anderson's arrival at the museum. Taverner was having great difficulty obtaining hard-wood sawdust for use with the large mammals that would be arriving, because the Mint had recently taken the museum's regular source of supply for packing their gold coins. He also had to find office space for Anderson and his specimens, all of which were large. Writing to Brooks in France he told him:

> "The Arctic Expedition has returned and I expect Dr. Anderson daily. You know he is to be our mammalogist, and it will be a relief to hand this stuff over to him."

The two men met for the first time in October 1916.[20]

Anderson assumed his duties as zoologist, and took charge of the mammal collection at the museum. At the end of 1916 he was appointed to the Advisory Board on Wildlife Protection. Through membership of this Board, which met eight times in 1917, Anderson got to know several key men in the departments most concerned with wildlife. These were: James Harkin, Parks Commissioner; Gordon Hewitt, Dominion Entomologist; James White, secretary of the Conservation Commission, and Duncan Campbell Scott, Superintendent-General of Indian Affairs.[21] Late in 1918 Anderson, together with Hewitt and Harkin, interviewed Hoyes Lloyd for the post of ornithologist with the Parks Branch, to be responsible, in particular, with enforcing the Migratory Birds Convention Act.[22]

In 1917 Taverner introduced Anderson and his wife to the Flemings in Toronto.[23] This gave Anderson someone with contacts in the world of ornithology, outside of government people, with whom he could correspond. During the summers of 1918 and 1919 Anderson was loaned to the National Parks Branch for work inspecting large areas of lake, swamp and agricultural land in Saskatchewan and Alberta reserved for wildlife sanctuaries and proposed for wild fowl breeding grounds.[24] In telling this news to Fleming he mentioned that "Mr. Harkin is going out as far as Regina with me". In the same letter he enclosed an "accession card" notifying the birth of a daughter.[25]

In another letter to Fleming of 1919 Anderson mentioned that he had been down to Point Pelee on Parks Branch work and that W. E. Saunders and Dewey Soper had come for the weekend, and they stayed together over Sunday at "the shack". Soper was just beginning a career in which he was to become an outstanding explorer-naturalist in the next decades. He was delighted to meet Anderson and told Taverner in a letter:

> "Dr. Anderson was with us … he had so many interesting things to tell us about the north country. It may be that he will not realize just how much I enjoyed his company."[26]

In the same period Anderson passed various requests and suggestions to Jim Macoun, who was running the biological division during his father's partial retirement in Victoria, British Columbia. Taverner was pleased when Jim was made permanent acting head of division and told Fleming

> "I am glad this appointment has been made. He is the right man in the place … I get along with him very well indeed …"[27]

By mid-1919 the Taverners and the Andersons were beginning to get to know each other now that the Andersons had a house near the Rideau Canal, and Mrs. Anderson had a daughter, Dorothy Ann, one year old in August 1919. Taverner took Anderson to Blue Sea Lake for a weekend to look at possible sites for building a cottage. In writing to Jim Macoun Taverner said that they had "a fine visit" and added: "He certainly opened up in camp and makes a good camp fellow". In October Anderson bought a lot on Big Island, quite near to the Taverners.[28] Together Taverner and Anderson worked out the principles on which collecting permits could be issued. James Macoun, who was becoming progressively ill, died in January 1920. No worse a stroke of bad luck could have struck Taverner. His good friend "the genial, unassuming" James Macoun was gone. Taverner wrote,

> "Personally I feel that I have lost one of my best friends, one upon whose judgment and willingness to assist I could rely under any circumstances. Departmentally he is irreplaceable."[29]

In March 1920 Rudolph Anderson was made acting head of the Biological Division under whom Taverner, as ornithologist, was to serve for the next 17 years. Taverner regarded the position of the museum in relation to the Geological Survey, as it developed early in 1920, as a fight for survival. But Anderson, who should have been a strong voice in his position as head of the Biology Division, kept quiet.[30] Taverner tried hard to persuade Anderson to take an active part without success. Writing to Fleming in March he said that he had been trying to rouse Anderson to action "but he is hard to wake". Taverner showed that already he had summed up Mrs. Anderson astutely when he said:

"Will have to get after his wife, she sees things as they are, and is a hustler and is determined that he will hustle too. Cannot make [up] my mind just where Anderson stands."[31]

To Taverner, Anderson may have seemed difficult to understand, and hard to rouse, but there may have been a very good reason for his attitude. We shall now take a look at some of the effects that the return of Stefansson from the Arctic were to have on Anderson and his companions of the Southern Party.

Anderson had the unpleasant experience of facing Stefansson, the expedition leader, at Collinson Point Camp from December 1913. A major confrontation developed in February 1914 when Stefansson realized that he must challenge the "dissidents" of the southern party before they undermined his position and creditworthiness on the Arctic coast. Stefansson wrote to the deputy minister of the Naval Service, G. J. Desbarats, that he ought to bring the dissidents into line; that Anderson should attempt to carry out instructions given him by Stefansson, and that just because Anderson considered some other course better should not be considered an adequate excuse for *disobedience* [emphasis added]. Each side felt justified in its own position and Stefansson regarded Anderson's position as *mutinous*; while Anderson was under the strain of challenging Stefansson in order to protect what he considered to be the *rights* of the southern party.

Stefansson came to Collinson Point camp again, after a visit to Herschel Island, on 8 March 1914, fully determined to "have it out" with Anderson and his party.[32]

After Stefansson's return from the Arctic in the fall of 1918 the disagreement between the Canadian Naval Service, the Geological Survey and Stefansson centred round the publication of the reports on the work carried out by the expedition. Already some of the papers on the scientific results of the southern party were being written. Anderson had been given the task of writing a narrative of the journeys and field trips of the southern party. The deputy minister of Naval Service, Desbarats, wanted Stefansson to complete his report on lands explored north of Prince Patrick Island so that the government could lay down a chart of the lands he had discovered. Since the southern party's publications were progressing well it was necessary that Stefansson should carry on with his. But Stefansson had his own plans and gave priority to an immediate lecture tour, and the writing of his unofficial version of the expedition under the "loaded" title of *The Friendly Arctic*. When published in 1921 it caused a furor, especially in the Anderson camp. Mrs. Anderson put the matter forcefully:

"Steffy does not realize that he is fighting the Canadian Government when he fights Rudolph ... [T]here is no room at the present time in Canada for VS and Rudolph at the same time unless Steffy reforms ... he must be taught to play fair."[33]

A long letter from Diamond Jenness disputing many of the allegations made in *The Friendly Arctic* was published in the prestigious journal *Science*. Using documentary evidence Jenness was able to cast doubt on Stefansson's ability to live off the land. A heated dispute developed between Jenness, Anderson, the southern party and the Geological Survey on the one side, and Stefansson with his various backers on the other.[34]

Walter Brock, who had resigned in 1914 to become dean of the Faculty of Applied Science at the University of British Columbia, wrote to Camsell in 1923 about the rights and wrongs of the quarrel between the two parties. It was a judicious letter from the man under whose leadership the southern party had been planned. He suggested that only harm could come to all concerned by pursuing the matter further,

"it has gone too far already ... I do not think for the personal vanity or private satisfaction of one or a few individuals, the officials or any others should be dragged into this dirty mess ... In the end, the individuals, the parties and the expedition will be judged on one thing only and that is the scientific results they present to the public."[35]

Unfortunately, a report on the zoological results of the expedition due to be published in volume 2 (mammals and birds), and written by Anderson, never materialized.[36]

When *The Friendly Arctic* was published Anderson gave vent to his feelings of anger and frustration by writing letters to those he could trust to take his side. One such was J. H. Fleming with whom he had been in correspondence since 1917.[37] In an angry letter of late 1921 Anderson complained that he had been taken to task in a review in the New York Times book review section of *The Friendly Arctic*. This was obviously by some literary hack ignorant of Arctic conditions, Anderson stated, among other things. It was a powerful piece of argument.[38]

Anderson wrote several more letters to Fleming on the same subject and in the same tone of frustration and suppressed anger. Eventually in 1924 Stefansson realized he was no longer *persona grata* in Canada and his later Arctic activities were carried out in the United States.[39] As a result the Andersons now appeared to be on good terms with most people, although two civil servants in Ottawa were soon to feel Mrs. Anderson's displeasure.

Although the collection of birds obtained by the Canadian Arctic Expedition was a good addition to the museum, many more arctic specimens were still required. In 1923 Taverner and Anderson arranged for Dewey Soper to go to the arctic as naturalist in the annual expedition of the Canadian Government Steamer (C.G.S.) *Arctic* visiting Ellesmere and Baffin Islands with supplies for recently installed

police posts.[40] It was impossible to carry out any extended scientific investigations during the short stages of an arctic summer voyage as the ice packs were only open for a short time. To make extensive investigations and collections in zoology, botany and ethnology it was necessary for a zoologist to winter there and spend the following season on intensive field work. As a result the museum decided to send Soper to Baffin Island where the prospects of a large, unknown field for exploration were good. Soper sailed from Quebec in C.G.S. *Arctic*, commanded by J. E. Bernier, and landed at Pangnirtung, Cumberland Sound, on the southeast coast of Baffin Island on 22 July 1924. During a violent storm in the north Atlantic a large part of the ship's cargo was lost, including coal. Soper decided to land at Pangnirtung on the outward voyage in case no stop could be made there on the return run.[41] This was a wise decision because it enabled him to explore parts of the area with help from the Hudson's Bay boats, and a power launch of the RCMP, and during the fall of 1924 provisions were laid down near the head of Nettilling fiord and more provisions in the spring. Soper, with Constable T. Tredgold, RCMP to accompany him on an exploratory police patrol, with Eskimos, sledges and dogs left Pangnirtung in April, arriving at Nettilling Lake about 180 miles to the west in May. The summer was spent collecting, surveying and photographing. Soper's report, written in September 1925, told of his plans for wintering, and what he planned to do during the summer of 1926 when he hoped to find out something of the nesting grounds of the Blue Goose, [now considered a blue morph of the Snow Goose] which were still unknown.[42]

This was Soper's first arctic expedition. He arrived in Ottawa in October 1926 just in time to give a brief report on his ornithological work on Baffin Island to the AOU meeting in Ottawa. Writing to Bishop about Soper's discoveries Taverner said that he had hoped for more gull data, but he was glad that Soper had found a colony of Kumlien Gulls [Iceland Gull] breeding, together with Glaucous and Herring Gulls on the south shore of Baffin Island.[43]

The AOU meeting at Ottawa in 1926 ending in a weekend excursion on Blue Sea Lake was, in some ways, the climax of Taverner's career. He was in high spirits (perhaps a little too pleased with himself) in his letters to Laing and Bishop. The greatest hit, he told Laing, was to present every registrant with a copy of *Birds of Western Canada*. This was substantial, well printed, and well illustrated — a book to be proud of. He told Bishop that entertaining an AOU meeting was "rather heady business, — but a barrel of fun". He found it difficult to settle down to the humdrum routine again. Anderson also seemed pleased with the results of the meeting, and wrote nicely about Taverner's book.[44] But perhaps Taverner may have seemed a bit too pleased with himself. From this time onwards warnings of trouble ahead began to appear.

The continuing feud between the Andersons and Stefansson appeared to be still simmering deep down. Writing to her husband from the cottage in August 1926 Mrs. Anderson mentioned carbon copies of letters about "Steffy" which he had left on the mantlepiece. She said: "You might care for my opinion on a few points."[45] Now, a fresh cause for Mrs. Anderson's disapproval was Percy Taverner. In July 1926, Karel Wiest, who was staying with his mother, Martha, at the Taverner's cottage, was reported to be planning to have a huge bonfire there. Mrs. Anderson sent a message to Karel that he was a guest on the island, that he was to read the regulations and abide by them. She also told her husband to speak to Ida Taverner about the matter. Apparently Karel did not have the bonfire.[46] Another new target of her disdain was Hoyes Lloyd. Writing to her husband at the beginning of November she said:

> "I heard the supervisor of wildlife protection was slaughtering birds on *our private* property for his *private* collection. I was at first minded to call up his chief [Harkin] and ask him what *legal* right Mr. Lloyd had to do this but on reflection called up the president of Big Island Community [Mr. Patch] and told him about it confidentially".

What she wanted was to have their island made a sanctuary, and signs posted to that effect. At the top of page 1 she wrote "Mr. Harkin better tell Lloyd again he is a flat-footed policeman and nothing else."[47]

The next day she wrote again with second thoughts.

> "On reflection I am inclined to think our friends, the Lloyds, are doing only what P.A.T. wishes and consequently I would not blame them so much. I wonder how Percy or Mr. Lloyd would like it if you would take a shot gun and, armed with your permit to collect birds in Ontario, go into their back yard in Ottawa and shoot birds they brag about seeing there? …
>
> I am sorry Mr. Lloyd is secretary of the Advisory Board & Wild life Protection. A much better secretary would be Mr. Lewis who practices what he preaches as I understand. I honor Mr. Lewis more than ever …
>
> As to instructions from P.A.T. to Mr. Young — that seems queer. Doesn't the chief of the Biological Division give his instructions to his own field party? I fear the help and advice of the bumptious ornithologist was not needed — or appreciated."[48]

So Taverner was conceited and assertive, and spoke out of turn.

In a letter Anderson wrote to H. P. Allstrand, an uncle of his wife, in the following year he said something rather enigmatic.

> "My health has been fine for the past year, never better. I have been weighing consistently around 182-186 lbs for a year or more. I have not had a scrap with anybody for

a long time now and it is about time to knock on wood. If it keeps on this way I shall be loving all my enemies, and some of my friends say that I need a scrap occasionally to keep in the best form. There are two or three that I have not forgiven yet, however, but am not worrying about them.[49]

Taverner had an unpleasant setback at this time when he asked Laing to go with him as assistant ornithologist on a field expedition in 1927. Taverner thought that he had written early enough only to find that Anderson had already settled with Laing to come with him as an assistant mammalogist.[50] This was partly Taverner's own fault caused by the over jocular tone of his letters to Laing. This is how it started in early February, when Taverner wrote to Laing assuming that he would be too busy to go on a field trip in the summer because he and Ethel had at last got married on 19 January 1927. These were his words:

"Good bye carefree bachelor days, working all summer for nothing, guess I have seen the last of you in summer field work. Golly, I hope Harrold does not desert the ship just yet."[51]

This proved to have been a silly thing to have said. Taverner had been taken off guard, and Laing's reply showed that he was hurt by Taverner's assumptions.

"I like the way you put me, as an old married man, on the shelf regarding field work … it relegates me to the ranks of the mouse-catchers … you come right out and kiss me good bye."[52]

Taverner knew Laing better than to expect that he would pass up field work, just because he had recently got married. That was not his style. This is how Laing's biographer explains it.

"The role of 'the woman' was clearly defined to Mack. Women were put on earth primarily to help men in the struggle for existence. Only after they had accepted their subsidiary or service role by getting married could they expect something approaching equal treatment or respect from men."[53]

In March Taverner learned from Anderson that Laing had been hired by him for summer field work. Taverner was hurt and reproached Laing when he wrote:

"It was rather a little shock to learn that you are thinking of going out this summer for Anderson. Think he at least might have told me of it or consulted with me again."[54]

Laing replied:

"Well, how in heck am I to know what you fellows are consulting about down there? Anderson asked me if I can go as usual and I said where and as you sort of kissed me goodbye when I got married, I naturally supposed you have side tracked me. Truth is that I suspected just the truth and feel between the upper and nether millstone."[55]

At this point Taverner wrote to apologize for the mix up in the arrangements for the field work for the 1927 season. He explained, rather weakly:

"Suppose I should have closed up immediately I found that you were willing to go out again. If you had not been such a bum correspondent this winter [I] probably should have. I assumed that you would want to stay home with wifie this summer. Your disclaimer was long in coming and I had no idea that Anderson was dickering with you as a mouse."

He mentioned that Harrold was now going to Alaska for the California Academy of Science, and added that losing both him and Laing was the last straw that made him remain at home for the summer.[56] Taverner had assumed too much, and had been taught a lesson. In the fall of 1927 he wrote to Laing:

"Hope that next year you will be with me doing nice bird work again instead of hunting shrews and such verminous creatures."[57]

But in January 1928 he received a cordial but firm reply. Laing explained that Anderson wanted him to continue the past summer's work on mammals along the B.C. border, and he said he would, providing that Anderson would make arrangements for Laing's wife to come with them. He explained to Taverner that breaking up one's home for a hundred dollars a month for six months of the year is not what it used to be. That is the reason he would skin mice and things. His wife, he said, made a good assistant and could make as good a bird skin as he could, though very slowly.[58] Taverner and Laing never went on a field expedition together again, though it didn't prevent them remaining friends and writing letters to each other, though less frequently.

The "flare up" between Anderson and Taverner in early 1925 had soon settled down, and the few letters they needed to write to each other were quite friendly. But by early 1927 there were signs of coolness between them. At this point it may be helpful to explain the official position of the two men at the museum. Taverner's title was ornithologist, Anderson's was mammalogist, until he was made "chief of the division of biology" in 1920. This placed Anderson one step above Taverner in the civil service hierarchy. Anderson was now responsible for all returns and reports from the biological division (ornithology, mammalogy and botany). Anderson's military training may have made him sensitive to his rank, and his duty as head of a division. Everything that Taverner wished to have done in the museum had to be discussed with Anderson first, and any letter on official business would have to be approved by Anderson. If Taverner wrote an article that he wished to have published this would have to be submitted first to Anderson who would edit it, correct Taverner's spelling, and discuss its content with Taverner, if he wished. In more technical matters Anderson considered it his duty to keep a watch over administrative matters which Taverner, in his position of the museum ornithologist, considered to be his responsibility. These included the loan of study skins to other museums, and to individuals such as Fleming and Brooks who were semi-professional

ornithologists. If the museum had sufficient duplicates of a particular species in a particular plumage, then an exchange of skins might be made with another museum or individual, thus helping to build up the museum's collection. Just as stamp collectors may exchange their duplicates for ones they do not possess, so collectors of bird skins made exchanges. But in the case of a museum the responsibility of the curator of the ornithological section was considerable. It required considerable knowledge and judgement, as well as an efficient system of registering all birds received into the collection, and all birds sent to other institutions and individuals on loan, or on exchange. Taverner started by keeping such a register entitled "Victoria Memorial Museum Register of Birds" which was kept from 1911.[59]

Another humiliating thing for Taverner was that he had to make all applications for leave time, and for attending a conference, through Anderson and not to the director of the museum. As a result Anderson could advise the director whether he felt that Taverner should be granted any request. Also Taverner's yearly reports on the work done by the ornithology section for the previous year for publication in the Annual Report had to be submitted through Anderson. Because Taverner had been his own "boss" during the period 1911 through 1919 this was a particularly galling thing to have to do.

As we have seen, Dewey Soper returned from his second arctic expedition in the fall of 1926. These two expeditions had been arranged by Anderson and Taverner jointly for the National Museum. Soper's

Joseph Dewey Soper upon return to Cape Dorset after surveys run to Nuwata across the interior of Foxe Peninsula and from there east to Ungmaluktuk Lake and south to Gordon Bay during March 1929. Reproduced courtesy of the University of Alberta Library Archives, The J. Dewey Soper Collection, 79-21-34: 1579. See W. E. Stevens and George W. Scotter. 1983. *Canadian Field-Naturalist* 97(3): 350–355.

third expedition to the eastern Arctic was sponsored by the Northwest Territories and Yukon Branch, Department of the Interior, because the National Museum could not find a permanent post for Soper, though Taverner gave him his support. There were still several species of birds whose nesting grounds in the arctic were unknown. One was the "Blue Goose" which Soper had tried hard to find on Baffin Island, in 1925-26.[60] At that time the AOU Check-list (1910) showed the Lesser Snow Goose as having two distinct colour phases, the white and the blue. These were known to winter in Texas and Louisiana. Taverner's friend McAtee reported blue geese abundant in Louisiana with white-morph scarce. In Texas blue-morph geese were known to be scarce. North American ornithologists were specially interested to discover where the breeding grounds of the "Blue Goose" were. They also wanted to discover how it managed to retain its blue genes and remain a separate species.[61]

In 1928 Soper returned to Baffin Island, reaching Cape Dorset in August, making his headquarters at the Hudson's Bay Company post there. From there he made various important journeys by land and coastline, exploring in southwestern Baffin Island, with one or more Eskimo assistants and several teams of sled dogs. The stamina of Soper, the Eskimos and their dogs is vividly described in words supported by photos, in two articles by Soper covering a whole year of arctic travel.[62]

When spring arrived Soper had developed considerable familiarity with the vast Foxe Land interior and the Foxe basin coast. He had twice been over the region in which the "Blue Goose" was thought to nest, and knew the best route by which to reach his proposed quarters for the summer. On 17 May 1929 he left Cape Dorset with five Eskimo drivers, four sledges and forty-two dogs, carrying sufficient food and equipment for a period of three months in the interior. After eight days of hard travel they reached the proposed site of their summer camp on the banks of a river near Foxe basin at latitude 65°35′ north. This they named Camp Kungovik, the Eskimo name for "Blue Goose". Three Eskimos with all the dogs and all the sledges started on the trail back to Cape Dorset. Two Eskimos — Kavivow of Cape Dorset and Ashoona of Gordon bay remained to assist Soper. They relied on a single freighter-canoe with which to navigate Foxe basin and travel by rivers and lakes across Foxe Land to Hudson strait in August when the ice was melting — a daunting challenge.

The first geese passed over camp on the evening of 2 June, the next on 5 June when 34 alighted on a snow-free strip bordering the Kungovik river — twenty four of them were "Blue Geese". By 8 and 9 June thousands of geese were crowding bare patches of tundra in the region. By late June the lowlands were rapidly being cleared of snow and breeding birds were withdrawing to the nesting areas. By now the migration was over, and "Blue Geese" were in the majority. Soper and his assistants searched the region on foot for nests. Finally, on 26 June a small colony of breeding geese with ten nests, eight of which were of the "Blue Goose", were discovered. Several years previously Kavivow had tramped through this region on a caribou hunt, and had noted a place eight miles southwest of Camp Kungovik. It was here that they were now busy collecting birds and sets of eggs. On that date Soper wrote a two page letter to Taverner describing what he had seen. He said, in part:

> "... notwithstanding the wretched climate, I have witnessed some wonderful events. A book could do justice alone to the details. As a bird migration route and a breeding grounds it eclipses by far anything I have ever beheld in the past. Think of a region swarming with Blue Geese — during the migration geese of all kinds, and Brants —, and around camp to have such birds commonly nesting as Red Phalarope, White-rumped Sandpiper, Parasitic and Long-tailed Jaeger, Black-bellied and Semipalmated Plover, Ruddy Turnstone, King Eider, Black-throated Loon [Pacific Loon], Sabine's Gull and — a little removed, Blue and Snow Geese! Yes, indeed, it has been a great experience, especially during the migration, with thousands upon thousands of these birds and others swarming over the snow-free patches of tundra on their way to higher latitudes. For music, we depend as usual, upon the abundant [Snow] Bunting and Lapland Longspur, the darlings of the lonely wastes.
>
> I have added several new species to the Baffin Island list, names which I have carried around in anticipation before, blank spaces since 1923! And as for collecting, it is a paradise for northern birds. And by the way, I have among other things discovered the real Baffin Island migration route of the Purple Sandpiper — it is right past Camp Kungovik! — by the tens of thousands, compact flocks of hundreds, so closely ranked on the restricted areas of bare ground at time of passing that a single charge would desolate half a hundred future homes at once."

In the last paragraph he tells Taverner that as soon as the ice disappears in the southern part of Foxe Basin they will embark on the river, and begin the long voyage to the sea.

> "From the basin our route lies thru a partially unexplored chain of rivers and lakes thru the heart of Foxe Land to Hudson Strait. Luckily, I know more than the half of it from explorations and mapping conducted last fall, so may now lay my plans, as [I did] before leaving Dorset, to the very best advantage."

He ended this letter with the words

> "Adios, senor
> Dewey
>
> P.S. This camp is named from the Eskimo for Blue Goose."[63]

This is a letter that should be known to all Canadians as an account of an epic in the exploration of the Canadian arctic, as well as the discovery and first hand study of an arctic breeding species of birds. (A photocopy of Soper's handwritten letter is

A photograph received by Taverner in January 1930 from someone as a gift. It was 4 x 2 1/2 inches. Percy had it framed and gave it to his wife, Martha Wiest, after they were married in 1930. She kept it until just before her death when she gave it to her son, and just before his death he gave it to John Cranmer-Byng. (Reproduced courtesy of the Canadian Museum of Nature, number 100028.)

included in Appendix 1 at end of book). The importance of the achievement of Soper, together with the work of Kavivow and Ashoona, has not been forgotten. A large area on the western side of the Great Plain of the Koukdjuak is now named Dewey Soper Bird Sanctuary, while a bay north of the Koukdjuak river where it flows into the Foxe Basin bears the name Taverner Bay. North of this lies a river named by Soper for the explorer and ornithologist Bernard Hantzsch, of Dresden in Saxony, who died there in June 1911.[64]

One of the first North American ornithologists to ask to be able to see specimens of the "Blue Geese" was Frederick H. Kennard, Curator of the Museum of the Boston Society of Natural History. Kennard was gathering material on geese for a study of the genus *Chen*, and had requested a specimen of the "Blue Goose" for his museum.[65]

In 1928 Anderson was appointed naturalist to the Canadian Arctic Expedition for that year, and sailed on *S. S. Beothic* from Sydney, Nova Scotia, in July.[66] In 1929 Taverner accompanied the annual expedition on the *S. S. Beothic* as naturalist, sailing from Sydney on 20 July. The reason for the annual expedition was that from 1903 the Dominion Government had been extending its administration northwards, and advanced police posts had been established as far north as the Bache Peninsula on Buchanan Bay off Norton Sound. RCMP officers of these posts had carried out wide-ranging patrols over formerly inaccessible country, and had collected information and species of value, which had reached the National Museum of Canada. The voyage was a circuitous one, depending to some extent on what supplies were required, and the condition of the ice. After sailing to the west coast of Greenland the *S. S. Beothic* went as far north as the Bache Peninsula post on Ellesmere Island, then to Devon Island and Pond Inlet, then Pangnirtung on southeast Baffin Island. A special trip was made to Chesterfield inlet in Hudson Bay for provisions and coal for the RCMP detatchment there. Taverner returned to North Sydney on 3 September after a voyage of 7800 miles lasting a month and a half. He told Fleming that he only obtained 65 specimens. He collected about six species that he had never taken before. The most interesting were Hudsonian Curlew [Whimbrel] and Red-backed [Dunlin] and Stilt Sandpipers from Chesterfield. The Red-backs were in an interesting plumage change which he had not seen before. He then raised the question of where the Hudsonian Curlew bred, a subject which he discussed in detail in an article published in 1942.[67]

Taverner summed up his experiences during this voyage in an account in *The Canadian Field-Naturalist*.[68] The National Film Board made a film of the expedition to the arctic on the *S. S. Beothic* in 4 reels containing a brief description of subject matter, including "Shots of naturalist P. A. Taverner, and J. Dewey Soper discoverer of the nesting place of the Blue Goose".

On the return voyage the *S. S. Beothic* called at Lake Harbour, Baffin Island and Taverner's Journal read: "Aug. 17 Lake Harbour — D. Soper not yet arrived from Cape Dorset." Almost at the last moment Soper hurriedly arrived. The two men had a great opportunity for plenty of talk on the homeward journey via Chesterfield Inlet, Burwell Harbour, coast of Labrador, Strait of Belle Isle to North Sydney Harbour. Soper's outstanding success on the Bowman Bay breeding ground of Foxe Basin, and Taverner's opportunity to see parts of the eastern high arctic from on board ship excited his mind with the wish for new opportunities for studying more of Canada's Arctic breeding birds on their breeding grounds.

It was no surprise that Taverner planned his field work during 1930 for the arctic. Problems of transportation caused him to choose Churchill, Manitoba, which he said in a letter to Munro, would give him a base line from which to start, since he was anxious to work northward in future years.[69] Taverner, with A. (Bert) C. Lloyd as taxidermist made camp near Churchill in late May where they were joined by Victor E. Gould, of Wolfville, Nova Scotia, as student assistant. They collected a few miles north of Churchill. Taverner left Churchill at the end of June, Gould and Lloyd in September. They made a useful collection for study and exhibition purposes including 650 birds and 68 mammal skins, and material for making habitat groups.

Early in January 1931 Taverner was making plans for the coming season, as he told Laing. "I want to send Bert Lloyd up to Pond's Inlet for a year if possible. I think it is a key locality for the Arctic fauna … " He explained that one could not get into the high arctic early enough to be able to do anything in the same season. The only way, he said, was to winter over in a location so as to be ready for the breeding season.[70] But Taverner's hopes for an expedition in 1931 were dashed because the economic situation was too serious for government to allot funds for field study expeditions from 1931 through 1934. However, an expedition organized by the Carnegie Museum of Natural History, Pittsburgh, Pennsylvania, under the direction of George M. Sutton, and John B. Semple, with Dr. Olin Pettingill and Albert Lloyd, went to Churchill. A second party, of individual ornithologists from Canada, consisting of Frank Farley (Camrose, Alberta) and Arthur Twomey, with two others spent June and part of July working the tidal flats, tundra, and bushland with their base at Churchill townsite. In 1932 Arthur Twomey, and Miss Marguerite Heydweiller of Rochester, New York, collected in the Churchill neighbourhood during June and July. As a result of

the field studies carried out in this region during the years 1930-1933 Taverner and Sutton collaborated in writing an account of what was achieved. This is a substantial study consisting of ten pages of historical introduction, and the problem of the naming birds as coming from "Hudson Bay" when they had often been found farther south. A brief account of the field work carried out by Taverner with Lloyd and Gould in 1930, and by others during 1931-1933, follows. A helpful description of the country around Churchill gives an idea of the habitat there (pages 5-10). The major part of the book is taken up by an Annotated List of Species. Taverner was responsible for the account, quotations and conclusions covering the work done in 1930 and 1932; Sutton for 1931. It is embellished with 13 black-and-white illustrations, a sketch map of the country round Churchill, and an attractive coloured illustration of a Hudsonian Curlew [Whimbrel], with a downy young, by Allan Brooks.[71]

Early in 1930 Taverner was reassessing his position as regards field work. Writing to the Director of the Museum, W. H. Collins, about an expedition to Hudson Bay in the summer. He said that now Harrold was dead, Laing was collecting mammals for Anderson, and Soper was in the Service of the Northwest Territories, it was important that others should be trained to take their places.[72] Writing to Mitchell in Regina about future field work he explained:

> "We have done the preliminary work in the southern part of the province, and can leave it for future developments, more or less to local effort, while we concentrate on the more inaccessible areas."[73]

Another reassessment he needed to make at this time was concerning the American field expeditions in northern Canada. While Taverner was working in southern Canada with two or three assistants things went well. But as a result of the arctic patrol voyage of 1929 Taverner realized that Canada was at a great disadvantage as regards ornithological work in the arctic. No Canadian university had the funds to mount an expedition, and only a few museums could do field work in the far north and then only in their own province. There were no foundations in Canada to donate funds for field study in natural science. When the big financial slump hit the economy in 1929 Canada had limited resources for even the National Museum, and from the season of 1931 until July 1935, no funds were available for field expeditions. However, wealthy American museums such as the Carnegie Museum of Natural History, Pittsburgh, and Museum of Vertebrate Zoology, University of California were able to carry on. This was a double blow to the National Museum of Canada because, while Anderson and Taverner were unable to fund anyone to collect birds and mammals in arctic Canada, American institutions could, and several did.[74] In the "Summary Report" for 1910 Walter Brock had clearly stated the national objective in natural history. "For the present, at least, the museum is confined to Canadian material, the object being to specialize in this until it becomes in all branches thoroughly representative of the whole Dominion, a place where the entire natural history of of Canada may be studied."[75]

Writing to W. H. Collins Taverner explained:

> "If we are to do serious and lasting ornithological work in the museum, it is practically imperative that we have certain series of extralimital specimens for comparison with our own. This is particularly true of arctic work where so many of our own species are circumpolar."[76]

The situation was especially tiresome to Taverner at this time because he was asked to revise the galley proofs for a forthcoming "checklist of the birds of the world" organized by the American Ornithologists' Union, the British Ornithologists' Union and the International Ornithological Congress. But his work was handicapped by not having access to the specimens he needed for the job. This may have been the main reason why he exchanged what he believed were surplus museum specimens, when an opportunity occurred, for extralimital ones not represented in the museum.

When the Ministry of the Interior decided, in 1933, that a descriptive account of the eastern arctic should be written, Charles Camsell, Deputy Minister of Mines, was approached asking whether Anderson would write on mammals, and also saying:

> "We would also be glad to have Mr. Taverner write up a section on birds. Due to his personal touch with the Arctic I think he would be the best person in the service to undertake this work."

The writer explained that the book

> "would be of value in showing that Canada has continued to actively administer the area. The importance of evidence of this kind is borne out in the case of Norway vs. Denmark, before the Permanent Court of International Justice."[77]

Taverner started with an eight page overview of ornithological collecting in the far north and Arctic, including that by Bernhard Hantzsch.[78] Five pages were allotted to a description of landscape, climate, plants etc. Taverner wrote economically and with precision.

> "The land is bare, the wind-swept hills absolutely so, elsewhere covered with mosses and low-growing alpine plants. The only shrubs are dwarf pencil-trunked willows raising scarcely six inches from the ground and grasses grow only in the most sheltered localities. The summers are short and with the aid of a twentyfour hour day, the hardy vegetation flowers, ripens its few seeds and prepares for the long bitter winter in weeks instead of months. Birds come before the ice has lost its hold and navigation is possible, nest immediately between snow banks, labor hectically to raise their young and are gone again in a few weeks. The difficulties of ornithological work under these conditions are considerable. Birds come and breed after sled travel has ceased and before water transport is practicable. By the time the

first ship or boat can introduce the naturalist to a chosen ground nesting is largely over and return migrations have begun to obscure the characters of the resident population."

Taverner wrote briefly about the effects of the ecological conditions on bird life. In the eastern arctic islands the short irregular season seeds are few so that seed-eaters are lacking, except for the Snow Bunting whose numbers are few per acre, and widely scattered. Ptarmigan, because they have the ability to feed on buds, twigs, fruit and bulky "roughage", thrive. Predators and offal-feeders of hardy forms such as Gyrfalcons and [Common] Ravens, Snowy Owls and jaegers, by covering considerable ground or occupying favourable situations, find sufficient subsistence. Taverner concluded by mentioning migrational routes through the area. Most waders worked up the west shore of Hudson Bay and the hinterland; few except for the Purple Sandpiper and the phalaropes seemed to travel the eastern (Atlantic) coast. He speculated that the area of the Melville and Boothia Peninsulas, of which little was known ornithologically, were important migrational highways into the centre of the archipelago. In the eastern arctic there were a number of European wanderers (intrusives) that arrive by way of Greenland. Just how extensive these foreign influences were, Taverner said, was one of the problems of arctic ornithology that they were attempting to solve.[79]

Although what Taverner wrote was interesting and well written it was not accepted for the book, issued by the Department of the Interior in 1934. Instead he wrote a section on "Birds of the Eastern Arctic", a useful resumé of 113 species found in the arctic regions of eastern Canada. Baird's Sandpiper was shown to have a high northern breeding range; the European Golden Plover to occur in Baffin Island as a migrant.[80]

While this was being printed Taverner received a letter from W. B. Alexander who was doing research in economic ornithology at Oxford University. Alexander had been appointed Director of the 1934 Oxford University arctic expedition to Ellesmere Island and asked whether Taverner could recommend any paper on birds of this area, or if not a list of birds likely to occur. This drew a reply from Taverner on how he saw the situation in arctic ornithology in 1933. In part he wrote:

"There is still a great deal to be done in arctic ornithology as much to correct old errors as to make new discoveries. The trouble is that so much of the arctic work has been done by inexperienced and casual observers that it is too bad that some one of qualified ornithological experience is not going to take part. We have learned considerable of late years but much of it goes to show how sketchy much of the old work inavoidably was. The time has come when careful and more intelligently directed work is desired in the high north."

Taverner told Alexander that the Ministry of the Interior in Canada was in the process of publishing a booklet for the needs of travellers and explorers in the eastern Arctic which would contain an annotated bird inventory.[81]

As an example of what Taverner knew in 1933, here are two items from his annotated check-list:

"Ross's Goose, *Chen rossi*, like a very diminutive Snow Goose hardly larger than a large Mallard Duck, is still one of the enigmas of the north, migrating through lakes Athabaska and Great Slave it disappears into the no-man's-land of the Northwest Territories. It may nest beyond the continental mass on Prince of Wales or Somerset islands or on the Melville peninsula and any data on it after it passes from well-known localities are desirable.

Kumlien's Gull, *Larus kumlieni*, though regarded by some as a hybrid between Thayer's and Iceland Gulls this is undoubtedly a distinct species for as yet its only known nesting localities are far removed from the breeding range of either of these forms. The demonstrated localities for the species are, Cumberland sound, southwestern Baffin island, and on the mainland across the strait near Cape Wolstenholme."

Taverner also reported Ross's Gull, *Rhodostethia rosea*, as extremely rare. When Soper was searching for the "Blue Goose" in 1929 he took a Corn Crake (*Crex crex*) in Cape Dorset which Taverner considered extraordinary but not impossible. In part, he wrote:

"There seem to be a number of these erratics that hit Baffin Island — [Northern] Lapwing, Barnacle Goose and this Rail. The flight line is probably Iceland, Greenland and Baffin."[82]

By 1930 relations between Anderson and Taverner were uneasy, and under the surface there were signs that not all was well. However, as long as Anderson and Taverner were able to get away from the museum for a month or more most summers on a field expedition they could just about bear each other's company for the rest of the year. But from 1931 through 1934 they were confined to the museum at close quarters because of the economic depression.

Writing to Rowan in May 1931 Taverner told him, in his graphic way, of the cutback in government funds.

"No field work this season, Government economising. Will be lucky if I don't lose my job. Heads have been falling right and left in the Civil Service and no one knows who will be next."[83]

Camsell, Deputy Minister of Mines, wrote:

"Field work in anthropology and biology, which in previous years has constituted the principal activity of the National Museum of Canada, had to be postponed altogether in 1931-32 owing to lack of funds … "[84]

Zaslow put the situation starkly when he wrote:

"In the biological field the four specialists — Anderson, Taverner, C. Patch, and M.O. Malte, the chief botanist — were reduced to three when Malte died in 1933 and

Rudolph Martin Anderson, May 1934. (Reproduced courtesy of the Canadian Museum of Nature, number J-6611.)

no replacement was sought for some years, the position being eventually filled by A. E. Porsild (1936). The competent museum specialists were trapped in a neglected, declining part of the public service with resulting frustration and lowered morale."[85]

The first indication of serious reductions to finances allotted came in a letter from the Department of Finance to the Department of Mines of August 1931 saying that it would be necessary to make curtailments in its expenditure programmes, and asking that the personal opinions of departmental officers should be sought. Camsell, as Deputy Minister of Mines, was asked to make a survey of services under his control in order to find out what might be postponed or curtailed, and tabulating the result into three categories:

Services that it was considered necessary to continue in full; that could be curtailed; that could be withheld during this fiscal year (1931-32).

An estimate of the savings which could be made under each item should be given.

With this letter from the Department of Finance was a request that an answer be sent urgently. Camsell happened to be visiting mining companies in Noranda and Timmins, and the Acting Deputy Minister, L. L. Bolton, had to relay information to Camsell as a result of his discussions with an official in the Department of Finance. One thing he learned was that this official put forward some suggestions, such as: Cancelling any proposed field work not already under way; recalling parties from the field forthwith; dropping proposed purchases of any new equipment; making no more purchases of museum specimens. There was no suggestion for curtailments that would result in a decrease in staff.[86]

At some time in the fall of 1931 Camsell probably had a meeting which included senior members of the biology division. There was an anecdote about Taverner and this meeting which was in keeping with his personality — he could be very outspoken when he wanted to put over a point. Apparently Camsell was explaining the situation, telling them that he needed to be able to assure the Finance Department that the biologists had important work to perform. He said he could not think of anything of importance for them to do since they could no longer have money for field work. Whereupon Taverner, who was acting as spokesman of the group rather than Anderson, at this point "balled Camsell out."[87]

As the world economic situation deteriorated from 1930 Anderson and Taverner found themselves struggling to fund their field projects. Eventually Parliament released sufficient money by mid-July 1935 to support 10 field projects for the museum, of which the biological division obtained money for three. Anderson was able to send out a party to collect mammals in the late summer and fall while their pelage was turning from breeding into winter coats. But for Taverner the bird breeding season was nearly over. Only some birds in fall and winter plumage could be collected while on migration. Therefore Taverner postponed a field expedition for another year.[88]

Until 1935 the lack of warmth between Taverner and Anderson was noticeable but could not be called animosity. They worked in close proximity, had to consult together continually, sat on several committees together, and attended various other functions in common. Taverner felt the Andersons' disapproval though he could not know the reasons why. He guessed that they were jealous of what he called "some little recognition" that he had received. There were other reasons which surfaced from 1935-36 onwards which made Taverner's position more than merely uncomfortable. It became unbearable. Taverner was so exasperated that he wrote to Collins, who was still director of the museum, that he found himself handicapped as the ornithologist of the museum, and put in an intolerable position. He said, in part:

"This has been caused by Dr. Anderson's recent and apparently unauthorized assumption of authority and interference that has never been exercised before over my office or over the coordinate section of Botany by him or his predecessor in office. Some of the unjustifiable methods of this interference you are already aware of ... "

Taverner argued that it had always been assumed that the ornithologist, mammalogist and botanist and other heads were duly authorized and responsible officers that knew their business and could be trusted to direct their own sections. Until such a person was proved incompetent or unworthy of trust there was no reason to hamper them by autocratic interference. He urged that the ornithological section be returned to the status that it had held for the past twenty-five years under which it had prospered and achieved some success in the scientific world.[89]

What had been some sparring between two men of very different temperaments and abilities now became something rougher. According to the Civil Service system and code of behaviour the man at the top of any division or department had considerable power over the next person under him, however experienced and able that person might be. Anderson certainly had the power; it depended on how he used it. The fact that the two men managed to carry on their work without any public quarrel was because they were expected to do so by the system. But it was very galling from Taverner's position. For example he had to take anything he wrote for publication in his work as museum ornithologist to Anderson to be edited. This meant that Anderson could make suggestions as to length, style, content. At times it could work to Taverner's advantage, especially when Anderson corrected his irregular spelling. Anderson was helpful in the publication of *Birds of Western Canada* (1926), but when

Anderson started suggesting, from 1935, that some of Taverner's short notes on ornithological matters were merely rewritings of articles that had been published twenty or more years earlier, Taverner was not impressed.[90]

In 1936 Taverner wrote to Laing telling him that relations between "the Dr." and himself had been growing worse for some years and had now reached a climax.

"I won't go into the dirty details but I have had some mean tricks played on me. Lately I have been made aware that he has been writing in a most derogatory manner of me to friends. He may have done so to you and I don't want to mix you up in private quarrels but to warn you against accepting all he may say in the matter. He seems obsessed with jealo[u]sy of me because I have received some little recognition and he has done practically nothing to obtain it in his 18 years here. Even his Arctic report is still to be written. However that is enough gossip. You will probably be under his orders this year though I hope that I have not lost your services indefinitely.[91]

Writing to Laing again the next month Taverner mentioned various matters and then added

"I don't want to get you mixed up in any personal disagreement we are having here."[92]

Another piece of information that Taverner included in the same letter was that there would probably be a change in the museum's organization.

"It is badly needed. The Biological Division is quite unworkable under the present circumstances. It is not my fault. I have been trying to avoid this condition for years."[93]

A few months later, writing to Brooks about a disappointment he had suffered over a collecting trip by sea for the museum that had fallen through, Taverner said that he did not know why, but he added

"R.M.A. is so d —- close that I know nothing that is going on beyond my own personal experience."[94]

In March 1936 the newly re-elected Liberal government of Mackenzie King began a major reorganization of the government. A new Department of Mines and Resources, with T. A. Crerar as minister (1935-1945), was set up. Camsell became deputy minister of this new Department. The reorganization took effect from 1 December 1936, with the minister and his deputy presiding over five large branches. Mines and Geology was headed by John McLeish, formerly director of the Mines Branch. It comprised three main divisions: the Bureau of Mines; the Bureau of Geology and Topography, which Lynch continued to head; and the National Museum of Canada, also controlled by Lynch. Taverner's sister, Ida, had married John McLeish in March 1930. Taverner was now the brother-in-law of the head of the Mines and Geology Branch.[95]

For some years Taverner and Anderson had been like two semi-blind men playing a game of bluff in which neither knew clearly what the other was doing. If that was all it was, the game might have ended when they both retired, as something rather comic for them to look back on. But this was not how it turned out. In April 1936 Anderson sent Camsell, Deputy Minister of the new Department, an eighteen page memorandum about the qualifications of ornithologists in the National Museum, and various other matters. This brought all Anderson's grievances about Taverner to the knowledge of the government officials.[96]

Taverner's requests to Collins to be given a Division of his own finally came to fruition soon after Collins died. Writing to Brooks in April 1937 Taverner was able to say:

"I suppose you know I have things straightened out here now. Am chief of my own division of Ornithology, it is only a one man department as I have no assistant — but I had none anyway."[97]

At the beginning of 1937 Taverner had an interview with Lynch, who by now had administrative responsibility over the National Museum (with Wyatt Malcolm under him as its effective head). In his record book Taverner noted:

"Agreed that the title Chief of Ornithological Division can be used as a semi official title of my office, though not at present recognized by the Civil Service list."[98]

In order to grasp the seriousness of the struggle between Anderson and Taverner we need to examine two major issues that inflamed relations between the two men from 1935 onwards.

The first issue concerned the proper procedure followed at most museums in the early decades of the twentieth century in making exchanges of bird specimens between one museum and another. It was for the head of the ornithological section to decide what specimens could be considered surplus at any one time, and what birds the museum needed in exchange. When Taverner was appointed the first ornithologist at the Victoria Memorial Museum in 1911 he learned, while visiting several museums in the United States, the usual procedure in the case of loans and exchanges. From that time onwards he was in charge of the ornithological section, and by the time that Anderson became Chief of the Division of Biology in 1920, Taverner regarded himself as well qualified to decide what exchanges should be made, without approval from Anderson. On the other hand Anderson, as Chief of Division, wanted to know what specimens Taverner proposed for exchange and to which museum. Unfortunately, in exchanging specimens in order to keep building up a collection there is no absolute standard that can be applied automatically; it has to be a matter of individual judgment. The problem was even more delicate when it concerned an exchange between a museum and an individual collector of bird specimens, such as Fleming, Brooks, Bishop and many others. By 1935, it was clear that Anderson expected Taverner to refer to him in such matters of judgment. This Taverner found unacceptable in his position of the

chief ornithologist at the museum. The following letter from Taverner to Lynch shows Taverner's position on the subject.

"This Division of the Museum, especially the ornithological section, is constantly receiving favors, especially in the way of rare specimens, from Major Allan Brooks, the artist and one of the leading Canadian ornithologists. Have just received from him four valuable additions to our collection. Major Brooks takes a great interest in the growth of our National collection and takes many opportunities to fill our gaps. These are not strictly 'exchanges' but I have tried in the past to render the exchange of courtesies not altogether one sided. I have a list of his desiderata and wherever we can spare any of these items I have supplied them. There is another side to the subject that should be considered. Major Brooks has what is probably the finest collection of "plumages" of North Americal birds extant. Through the war he had willed these specimens to the National Museum. I do not know his plans in this regard now but it is most advisable that we retain his interest in this museum, otherwise the collection may eventually go to some museum[s] in the States that I know have already made overtures to that effect.

The question is this, — Can I handle this material for this purpose, and in other necessary exchanges to my own best judgment or do I have to leave it to some one else less familiar with our collection and less informed as to its needs, strength and the ornithological questions involved? I have hitherto had full charge of the bird collections and have built them up from almost nothing to the best series of northern neararctic birds that there is. It is still not complete (probably never can be made complete) and there are many gaps to be filled. I do not see how I can fill them in the future as I have in the past unless I have as free a hand as in that past or until I fail to fullfill the responsibility in a satisfactory manner.

It is quite important that some decision re the distribution of responsibility in the ornithological section be arrived at shortly. An early decision is urged as I have to acknowledge Major Brooks' specimens immediately."[99]

A second issue that caused trouble between Taverner and Anderson was over the way in which the head of a section should deal with the results of a field expedition. One example was the Soper expedition to Baffin Island 1924-1926, and more important, the Soper expedition to the same area in 1928-1929.

When a field party collected birds or mammals the material was sent to the Museum to be accessioned, identified, catalogued and distributed into the collections.[100] Each year's accomplishments in field and laboratory work were published in the Museum's Annual Report. It was customary for the chief of each division to be responsible for the Report which was based on information submitted by the staff of his division.

These issues showed that there were substantial differences of outlook in what each believed was the best for the National Museum. Here were two strong willed men struggling for their position in the pecking order. By 1936 Taverner was desperate to get out from under Anderson's control. When he had achieved this by a measure of luck, Anderson was equally anxious to have Taverner disgraced. How he tried to ensure this can be seen clearly in his memorandum to Deputy Minister Camsell. But the Minister did not "bite".[101]

## CHAPTER 15. The Widening Field of Studies I, 1928-1936

*The Matamek Experience 1928*

Taverner's widening field of ornithological studies and experiences can best be shown to have started with his research papers on the Red-tailed Hawk (1927) and the Canada Goose (1931), as well as his arctic patrol voyage of 1929. They continued to expand until curtailed by the violence of the Second World War.

During his ornithological career Taverner's field work fell into three periods. Between 1911 and 1919 his expeditions, with one exception, were in eastern Canada. From 1920-1928 the major ones were in western Canada, with two lesser ones in eastern Canada (1924 and 1928). In the years 1929-1940 he managed two major ones in the arctic and two minor ones in northern Manitoba (1936; 1937).

In 1928, accompanied by Harrold, Taverner spent from early June to mid August on the north shore of the Gulf of St. Lawrence. Here they carried out field work in an unusual situation. They spent part of their time based on the residence of a wealthy American, Copley Amory of Washington D.C., at the mouth of the Matamek River where he had rented a salmon stream for the past twenty years. Luckily Taverner sent a descriptive letter about Amory's "establishment at Matamek" to his sister Ida. Explaining the situation he said it was not a camp but an establishment.

"... A good big house and about a dozen little ones grouped about like a hen and her chicks. A great big store house is the "Factory". We sleep in the upper story of it. A fine bed room in one side, and a regular biological laboratory in the other. A bright little French maid comes in daily and makes our bed and "reds" up the room, fills the pitcher and places fresh towels. Our tent is pitched just behind the Factory in its shelter, and here we work. It is often cold and raw, and our stove is a life saver ...

... The 'Big House' has just been all renovated. The floors are all newly scraped and waxed, and the woodwork throughout repainted. Two bath rooms, hot and cold water. A great big living room with a big fire place, a swing seat in front of it, and a table in the middle capable of seating twenty people — guess it is often filled too. Dozens of little cubby-hole bedrooms. ...

... On the rivers are numerous rapids demanding portages. There is a little sort of hut at either end of each portage and in it are a canoe and a skiff — you only have to portage yourself and chattels — canoes are ready at each end.

> Amory is a delightful fellow, an ideal host, and a very delicate and charming human. Mrs. Amory is here also — she is quite lame and is evidently rather an invalid and a bit petulant — sometimes more so, but Amory is a wonder of good nature and takes it with a smile."[1]

Although this was a difficult region to explore on account of the densely wooded coastline, Taverner reported that a collection of land birds was made considerably east of any locality on that coast represented in the museum collection to date. An earlier report on the Great Cormorant, called by Taverner "Common Cormorant", breeding on the north east coast of Anticosti Island was verified, about 100 nests found, and series of specimens obtained. In the *Annual Report for 1928* Taverner noted that though this once common species was enormously reduced, its situation was not quite so precarious as feared. A large rookery of [Black-legged] Kittiwake was located at Gull Bay estimated at some 75 000 birds, probably the largest in North America, Taverner wrote. A small rookery of [Northern] Gannets was also verified, making four known breeding places of this species in North America — Bonaventure Island, Gaspé; Bird Rock, Magdalen Islands; Cape St. Mary's, Newfoundland, and Gull Bay, Anticosti Island. According to Taverner:

> "A number of very interesting plumage observations were made on the water birds and considerable additions to our knowledge of their life histories were made."[2]

They also spent from 27 July until 7 August at Natashquan, but this was late in the season and they did not find anything of importance.

They returned to Matamek on 8 August. Here they took a number of Razorbills changing into winter plumage with their bill sheaths already shed, and their wings flightless. A Common Murre in the same condition was obtained. Reporting this to Charles Townsend in a letter Taverner commented

> "I never heard it advanced that these birds lost the power of flight in the summer moult but this seems to indicate that like the ducks they do".

In the same letter he said that midway between Anticosti Island and Harve St. Pierre on the east shore they came across two [Atlantic] Puffins in full winter or juvenile plumage with black shaded face and small bills.

> "Does the Puffin … take two or more years to arrive at maturity, and do they spend these adolescent summers at sea?"

Taverner asked.[3] It is refreshing to find a well established ornithologist making field observations of points about which he needed fuller information — a sense of excitement at being on the edge of discovery. In the 1920s an ornithologist could not easily obtain information that he wanted. Monographs on particular species had not yet been written, or if they had were printed in journals that had volume indexes, but not cumulative ones. However, Taverner was able to ask Townsend for information because Townsend was something of a specialist on sea birds having spent several summer seasons on the St. Lawrence and its estuary. By chance Taverner met Townsend briefly on the river steamer when travelling from Matamek to Harve St. Pierre. Townsend was about to be taken on a voyage along the St. Lawrence by Harrison Lewis in his capacity as Chief Migratory Bird Officer for Ontario and Quebec.

Taverner referred to the period from 8-18 August as "the Matamek meeting", though it was not a formal meeting but rather a pleasant "get together" of a few like-minded naturalists. In a letter to Bishop, sending news of his field work along the "North Shore", he wrote:

> "… Had quite a meeting of bird men at Mr. Amory's near Seven Islands. There were Kennard, Glover Allen, Francis Allen and Oberholser. The North Shore was overrun with bird men this summer. A. A. Allen was on it with Lewis for a while. Townsend gave it the once over and Todd worked it from Natashquan eastward. Did not see the latter however."[4]

When Taverner returned to Ottawa he sent Glover Allen some photographs and said how glad he was to have met him.[5] In reply Allen wrote to Taverner about a student of his by the name of Oliver Austin, Jr., who had made three trips to the east coast of Labrador, and intended to make use of material from there for inclusion in his Ph.D. thesis. He mentioned that Austin brought back two Lapwing *Vanellus vanellus* "which friends preserved for him …"[6] In reply Taverner quipped: "Hope Austin does publish his Labrador stuff but a bird man or a man doing bird work going on three such trips and not able to prepare specimens should be skinned himself".[7]

Altogether Taverner and Harrold collected 326 birds and 61 mammals, but no rare or intrusive species. It was not an entirely satisfactory field expedition. They started too late to see the full northward migration, but they explored the North Shore from Moisie Bay eastwards as far as Anticosti Island and Natashquan. The Matamec River and its tributaries provided them with good fishing.[8]

After returning from the Gulf of St. Lawrence Taverner wrote an article in which he outlined the extent of their expedition, and explained what was understood by the term Canadian Labrador in contrast to "the true Labrador". The main part was an annotated list of birds observed.[9]

Copley Amory organized an ambitious biological conference at his Matamek residence in 1931 from 24 July — 1 August, to discuss the significance of the "ebb and flow of animal and plant life of both land and sea, and the far-reaching effects of these cycles or fluctuations in abundance on the health, economic status, and general well being of the human population". The Federal Government and the Quebec Provincial Government sent delegates to take part in the conference. Charles Camsell acted as chairman.[10]

Although Taverner was not invited to the conference, Amory drew on him for help in trying to establish a sanctuary for eider ducks on the North Shore of the Gulf of St. Lawrence.

*The Taverners' Home Life, 1930-1936*

Percy and Martha were married at the end of March 1930, spent a fortnight's honeymoon in Washington and Charleston, then settled into Percy's home at 45 Leonard Avenue, just south of the Rideau Canal and west of Bank Street. For Percy this was no change but for Martha it was a major change of location and career, though Ottawa was not completely new to her, and certainly the cottage, "Hyla", on Blue Sea Lake was familiar to her and her son Karel. She did, however, keep possession of her house in Detroit. One of the first things they did, when settled into married life, was to buy a car — a 1929 model T Ford. Since Percy might have "a bad spell" at any time due to his heart murmur, he had never learned to drive.[11] Instead Martha soon learned, and thoroughly enjoyed herself when driving. Having the use of a car brought a new sense of freedom to travel to both of them. In November they motored to Cornell University to visit Karel who was studying architecture there. The next ten years of their married life were most enjoyable partly because of the holidays they were able to take in North America, sightseeing and visiting friends of Percy's in the ornithological world. One of their earliest trips was by automobile around the Gaspé Peninsula in July 1931. He described this holiday briefly in a letter to Brooks of early August when he wrote:

> "Got back Friday afternoon from the Gaspé trip. Had a most enjoyable time. Camped some five days on Bonaventure Island with my wife, almost in sound of the bird cliffs. Spent all our days on them watching the [Northern] Gannets and photographing them."

[Nothing more about their holiday — rest of letter about collecting and photography].[12]

Laing and Taverner kept up a correspondence which was almost more about gardening and listening to music than about birds. Writing to Laing in 1933 Taverner said that he was working on the rock garden. His old rockery, which he thought was the first in Ottawa, had not been built properly. But now that everyone had rockeries, he explained,

> "… I have to regain my lead in some degree … we have been scouring the country for nice mossy and worm-eaten limestone and sandstone. We run out in the evening, gather all the back seat of the old Ford will hold without dropping through, and bring them back in."[13]

The following summer he wrote to Laing

> "We have been 'rocking' violently all spring. The garden now is almost more rock than soil … The result is really pretty fine. Lewis [Harrison] just sent down a great package of alpine plants from the North Shore."

Taverner knew that there would be many failures.

> "Still", he said, "it is much more fun establishing things from the wild than ordering from a nursery firm."[14]

To Munro, in 1935, Taverner wrote:

> "Have had a great time this season with *Cypripediums* [orchids with pouched lip]. For the first time managed to get *acaule* [pink lady's slipper] to survive to a second season and am planting a lot more with lots of peat and spruce needles in the soil to see if that would suit them. Trying the same with the Ram's-head [*C. arietinum]* which as you know is pretty rare and supposed to be an even more difficult subject."[15]

But it was not always the climate nor the soil that harmed one's plants as Taverner's heartfelt words to Laing showed. "There should be a special hell for lying nurserymen. To spend five or six precious years growing trees and then to find them untrue to name is heartbreaking."[16]

In a letter to Soper in the fall of 1936 thanking him for some *mammilaria* [a species of desert cactus], for his rockery he asked him to look out for a very pretty little rock primrose that he once found growing in scree on the south side of the Cypress Hills.

> "It has a starlike pink flower rising from a whorl of leaves pressed close to the ground."

Taverner would be delighted to have a few roots. He then told Soper what he had been doing.

> "Have just built a rather ambitious new rockery in the garden. Have it partially planted and now all I can do is to wait for spring to see results. A number of the things I brought down from northern Manitoba seem to be doing well, — others were as could be expected failures or at least unpromising."[17]

In addition to gardening and entertaining friends, another thing that Percy and Martha enjoyed between them was music. This went back to the Taverner years in Detroit when Martha taught young Ida music, and the Wiests, Jacob and Martha, together with the Taverners — Ida Van Courtland, Percy and Ida Clare — took part in theatricals which involved them all in singing and making music. In the 1920s Percy and his sister Ida bought gramophone records which they greatly enjoyed playing. When Martha settled into her new role as Mrs. Taverner she started giving piano lessons to a number of children and teenagers at their home. Music at the Taverners' blossomed and brought them a great deal of deep enjoyment, which Percy passed on to Mack Laing in his letters. Percy also wrote to other friends about their music making. In 1931 he told Rowan

> "Dr. Eidmann was here a few days or so and I saw something of him. All Sunday he was playing four hand Beethoven symphonies and sonatas with the violin."[18]

Percy, when giving Mack advice on what to buy, said:

> "We have a very extensive library of serious music but have had to hunt the catalogues of the world to get them. They are making a great lot of wonderful things in Germany, Italy, France and England. Our poor little Canadian catalogue is most disappointing."

He then talked about the U.S. catalogue, and its great advantage over foreign ones especially the many recordings made by the Philadelphia

Philharmonic under Stokowski which were consistently the best orchestral records. During the winter of 1931-1932 the Taverners were lucky because a Philadelphia firm was selling off many foreign records at half price. They bought big sets of records such as Verdi's Requiem and Beethoven's Missa Solemnis

> "and a lot of other magnificent stuff. Of course now with all the tariff and super tariff and excise, dumping duties and the exchange [rate] there is no more ordering from abroad ..."[19]

In the same letter Taverner said he had been through the Victor list for 1931 and he recommended nine including Schubert's Trio, Opus 99, recorded by Cortot, Thibaud and Casals; Schubert's Seventh Symphony, and Beethoven's Fifth Symphony. He also gave Laing friendly advice on how to work up to enjoying symphonic music. Beethoven's nine symphonies, he said, were the best introduction to symphonic structure, and added:

> "You will probably recognize a great many of the themes from my old whistling as you did those of the Unfinished."[20]

Another piece of information was that the manufacturers were beginning to bring out long-playing records, and Beethoven's 5th Symphony was now on a double-sided record. "More long playing recordings can be expected", he said, "and will be a godsend, and will cost considerably less per composition than the old ones. I think we are on the eve of a great improvement in phonograph reproduction", he said.[21] However, by 1933 they could not buy much new music because of the cost due to heavy duties. Instead, Taverner described to Laing the music-making of their own that they were enjoying.

> ".... Two or three evenings a week of quintet, quartet, trio and good vocal stuff which is highly exciting. The wife has just started a course in musical appreciation that is also lots of fun and considerable profit. Of course she is trying to get a six weeks regular university course in ten lessons ..."[22]

He added that when they finished it he hoped that some of them would know the difference between Bach and Brahms.

One further letter, written in 1933 to Laing, contained good advice on appreciating music. Catchy tunes become tiresome with constant repetition, he said, acting more as a soporific than a spur to the mind. Instead, he wrote:

> "... I wish you could have attended some of our musical appreciation classes this winter and seen how these big symphonies are built up from definite and balanced plan, the best are really as much the result of a thought out architectural plan as a great cathedral and to listen to them properly is an intellectual as well as an emotional experience ...
>
> ... I cannot say that I know much about it but the little I do know has opened up worlds of keener appreciation to me than I knew existed. The idea that music could be anything but a sucession of agreeable sounds was a new idea to me as it is to most people. I believe no one can take such a work as this and know much about it at the first hearing or so ..."

In the same letter Taverner told how, one evening, he and Martha had a special musical experience. They went with Percival Price, the carillonneur, up into the Peace Tower in Ottawa to hear some new records he had brought back from Europe. This is how he described it.

> "... In his wonderful little studio, close under the clock and held up high in the air with lights out and only a glow from the quarterfoil windows all around we listened to Bethooven's Missa Solemnis, — 12 double sides, well reproduced. It was quite an experience."[23]

It seems that Percy and Martha were pleased with a letter from Laing of this time. Beethoven evidently "struck home" and Percy wrote: "That 'Ode to Joy' is a haunting thing and that is what was on the wedding announcement. You were quite foxy to catch it. Only two or three others got it and they were rather advanced musicians."[24]

Early in February 1932 Taverner was ill for a fortnight. Writing to Saunders he said jauntily that it was nothing much.

> "Have been laid up for a couple of weeks with a nice little attack of the 'flu'.
> However as it is the first time I have been really sick in thirty years do not think that I have much to complain of, especially as I am all back on the job and in good shape once again."[25]

To Laing he explained:

> "I got your letter of long ago when I was flat on my back with the 'flu'. As it was the first real illness ... in thirty years I have no complaint, especially as it all ended well."[26]

But Anderson, writing to Kenneth Racey in Vancouver, put it more strongly.

> "Mr. Taverner has been away for [from] the office for past nine days, in bed with cold or influenza at first, bringing back heart trouble."[27]

A return of his heart murmur was something that Taverner wanted to keep hidden from others, if possible. When he began 'rocking' vigorously from 1933 onwards he seemed to want to show his friends that he was strong enough to lift chunks of rock into the car and out into the rockery, but whether he was wise to do so is open to question.

About this time Taverner's eyesight was deteriorating. He first noticed it when taking photos of muskoxen on the northern patrol in 1929. Only a few out of 24 exposures were properly in focus. He had to use one pair of glasses to read the camera marks, and another to focus by. His long-distance sight was as good as ever, but he had to spend half the time putting his glasses on and off again.[28]

*A Study of the Red-Tailed Hawk and the Canada Goose*

Taverner put strenuous efforts into writing his first book, *Birds of Eastern Canada* (1919), for a period of

five years, and even then realized how very much there was still to be known about the major species. When he began to collect material for his next book, *Birds of Western Canada* (1926), he realized that he would have to put an even greater effort into working on the taxonomy of species such as the Red-tailed Hawk, the Great Horned Owl, and the Canada Goose when covering the whole of western Canada. By this time in his career Taverner knew that, as a professional ornithologist, he should not be content to write brief summaries of taxonomic relationships within a species, but must undertake a monograph or two on a large species, showing its several races, extending across North America, and where they intergraded or not.[29]

Furthermore, competition or jealousy among ornithologists existed as early as the 1920s. To have a monograph, on a difficult genus or species, published by a respected ornithological journal, or published as a book, and then to receive some reviews that gave it a favourable reception — this was the height of acclamation for an ornithologist in that period. By the time that Taverner had started, in 1932, to put material together for his third book, *Birds of Canada*, he had published two monographs that had caused him much work, thought and discussion.[30]

Taverner began working on the Red-tailed Hawk early in 1925 and corresponding with others on its colour variations. The problem he set out to solve was: what viable subspecies of *Buteo jamaicensis* should be recognized by ornithologists? During 1925, Taverner and Brooks were corresponding about Harlan's Hawk (*Buteo jamaicensis harlani*). Brooks had discovered, breeding in the Lake Atlin area of northwest British Columbia, Harlan's Hawks in sufficient numbers to suggest that it was a discrete geographical variant.[31] In reply Taverner said that until this time he had a "half formed conclusion that it [Harlan's] was an extreme phase of *calurus*" [Western Red-tailed Hawk (*B. j. calurus)]*. The only variation he could find for *harlani* was the marbled or mottled tail.[32] By the end of 1925 Taverner told Brooks that he now expected that he could write a paper on the situation as regards the Red-tails, with coloured illustrations of the various plumages.

> "I intend to make them rather diagrammatic, pictures of skins instead of living birds, and all alike in outline and form so that they can be readily compared. Will show you some of these drawings one of these days to show you what an astonishing lot they are."

In the same letter Taverner wrote that Laing had collected some very important specimens which might turn out to be key specimens to the whole situation.[33] Also Taverner had been obtaining interesting information from Norman A. Wood, of the University of Michigan Museum of Zoology, who had a collection of *harlani*, though they were all migrant specimens, mainly from Grafton, North Dakota.[34]

While Taverner was working on his monograph he was also hurrying on with *Birds of Western Canada* for a printer's deadline of early 1926. In this book Taverner stated that characteristic adults have brick-red tails, but western birds are so variable that colour, in the tail or any other part of the body, was an uncertain criterion for identification. In discussing subspecies of the Red-tailed Hawk he wrote:

> "The Eastern Red-tail *Buteo borealis [jamaicensis] borealis* extends westward through Ontario; but, beginning with the prairie sections in Manitoba, it intergrades, intermixes, and interbreeds so thoroughly with the Western Red-tail *Buteo borealis calurus* that there is great difficulty in defining the distinctive characters or saying where one begins and the other leaves off.
> … Besides these two forms, *borealis* and *calurus*, there are two others recognized by the Check-list that present peculiar problems to the Canadian ornithologist — Krider's Hawk *Buteo borealis krideri* and Harlan's Hawk *Buteo borealis harlani*. These are so variable that it is difficult to say just what are their distinguishing characters or whether after all they are not respectively just the light and dark extremes of the Western Red-tail."[35]

At this point we should examine Taverner's study of the *Buteo borealis* [*jamaicensis*] which was published in an issue of the Museum *Bulletin* a few months after his book.[36] Because considerable material had become available it seemed that this was a good time to make a critical study of the species. A large number of specimens, mainly of breeding birds, in many cases of complete families, were collected across Canada. Taverner was also able to borrow a series of migrant and winter specimens taken in North Dakota and Arkansas from the Museum of Zoology, University of Michigan, and important collections were studied at the Museum of Vertebrate Zoology, University of California, and specimens from various other university and private collections. This enabled Taverner to bring together a series of 157 skins for direct comparison.

The body of Taverner's study consisted of nine pages of discussion. He began with a general introduction. The species was considered by the AOU Check-list of that time to be composed of five subspecies:

*Buteo borealis borealis* (Gmelin), Eastern Red-tail
*Buteo borealis calurus* (Cassin), Western Red-tail
*Buteo borealis krideri* Hoopes, Krider's Hawk
*Buteo borealis harlani* (Audubon), Harlan's Hawk
*Buteo borealis alascensis* Grinnell, Alaska Red-tail [37]

Taverner pointed out that the principal characteristic of the eastern Red-tailed Hawk, the type form of the species, was its constancy of plumage. Over most of its range it had only a single phase [morph] which was brown.

After six pages of rather complicated explanation of the differences between the forms *borealis*, *calurus*, *krideri* and *harlani*, and the problems that ornithologists studying this species encounter, Taverner summarized his conclusions: — the Red-tailed Hawk of eastern Canada was pure *borealis*, a bird of practically constant character.

"The prairie provinces are inhabited by birds that are predominantly *borealis*, but with *calurus* features, more or less common intrusion of *krideri*, and at least a sporadic influence of *harlani* towards the west. Southern British Columbia is inhabited by practically pure *calurus*, and the far northwest, at least centring about the British Columbia-Yukon-Alaska boundary intersection, contains birds that are predominantly *harlani*, but with strong intermixtures of *calurus* and *krideri*."

Five pages of bibliography up to the year 1926 followed. Last but not least were three pages of hand-painted coloured plates which explained the author's discussion in the paper satisfactorily. Plate I depicted central tail feathers showing common variations in the principal subspecies at that date. Plate 2 showed 8 diagrammatic representations of body and tail colorations in *krideri* and *calurus*. Plate 3 showed 8 diagrams of characteristic body and tail colorations of *calurus* and *harlani*.

Taverner's study was reviewed briefly in *The Auk* by Witmer Stone. He summarized the main arguments and said that Taverner had "thrown much light upon a puzzling problem and we see no reason why his general conclusions are not sound". But he questioned the advisability of upsetting the current name of the Western Red-tail. "It is not a good plan to replace a certainty with an uncertainty in nomenclature".[38]

A longer, more critical review by Swarth appeared in *The Condor*. Swarth recently had a study of Harlan's Hawk published, and had crossed swords with Taverner at the AOU meeting in Ottawa in 1926. (*see* Chapter 13) He said that Taverner had produced an excellent summary of the range of variation that exists among the more northern of the currently recognized subspecies. Swarth continued:

"His descriptive accounts of subspecies and individual birds, together with the helpful colored plates, form an important contribution towards an understanding of this difficult species ..."

But Swarth could not accept Taverner's conclusion — that the current five names covered two forms only, an eastern race, and a western race, to which he applied the name *harlani*. Swarth then discussed the Red-tailed Hawk in detail and concluded that Taverner's treatment of the nomenclature should not be followed.[39]

Taverner had no expectation that his suggested changes would be followed. However, with the publication of Peters' *Birds of the World* volume 1, 1931, he considered that the treatment of the Red-tailed Hawks therein justified him in reviewing his previous study. Eventually his paper "Taxonomic Comments on Red-tailed Hawks" was published in *The Condor* in 1936. Taverner commented on a form *Buteo borealis alascenis* Grinnell that had been recognized by Peters but was not in the 1931 Check-list. He also commented on a subspecies recently described, *Buteo jamaicensis fuertesi* Sutton and Van Tyne, from Texas. Taverner was given the privilege of examining the type series of this race.[40]

*The Canada Goose*

During all the years that Taverner was ornithologist at the National Museum he was involved in the problem of unravelling the species of geese that breed in Canada. From the beginning of the 1920s Taverner was working on a book about *Birds of Western Canada*, and was writing to friends and acquaintances with knowledge of geese found in the western provinces of Canada. Brooks was the best source of information on western birds, especially ducks and geese. By 1923, Rowan, at Edmonton, was corresponding with Taverner on the Cackling Goose, a race of the Canada Goose, which shows an example of the kind of problems of identification and distribution that ornithologists faced during the 1920s and 1930s.[41]

When Taverner's *Birds of Western Canada* was published, those making a study of the species/subspecies of geese that might be seen in Canada were able to compare short summaries of information on them, together with coloured illustrations by Brooks and drawings of beaks of each by Taverner.

In his account of the Canada Goose, Taverner included the subspecies Hutchins, Cackling and White-cheeked Geese (pages 107-108). Writing of the Canada Goose *Branta canadensis* as a species, he said:

"Although few birds are as well known to the sportsman and general public, none is so little understood systematically by either scientist or layman."

(pages 105-106). Taverner said that on the prairies it was being exposed to the destructive effects of civilization, and feeding flocks were hunted by automobile from one patch to another. "Its disappearance would be a serious aesthetic and economic loss", Taverner wrote, and became quite eloquent.

"It is a noble bird, a point of interest in any landscape. No one fails to thrill at sight of its long V-shaped flocks flying over, or at the sound of its wild barbaric music coming down through the twilight. Domestically, the Canada Goose is a model for man. Unlike Ducks which mate for the season and then part for ever, Geese mate for life, mourn a lost mate, and are not easily comforted. Both sexes assist in the responsibilities of family life and if necessary share the supreme sacrifice in its behalf. We speak of the Goose as the personification of foolishness, but the Canada Goose is one of the most intelligent and wiliest of birds and exhibits occasional bits of strategy that are astonishing."[42]

Taverner next produced an eleven-page study of the problems of taxonomy within the Canada Geese.[43] He began by saying that recently much interest had been shown in the characteristics and complex relationships of the various geographical races of *Branta canadensis*. Although several attempts had been made to unravel them, the difficulties posed by dealing with what he called "mixed migrant material far from their

distinctive distributions" had been great, and no convincing solution had so far been presented. Now that breeding and summering specimens of geese, brought by Dewey Soper from Baffin Island, were available in the National Museum of Canada, Taverner considered that another attempt to clear up some of the problems should be made. After studying many specimens in various collections and considering the whole subject for a number of years, Taverner put forward several points in order to eliminate confusion in distinguishing five distinct groups. In the field, Taverner stated, "experienced sportsmen had far less difficulty in recognizing the various forms of Canada Geese than had the systematist working with specimens in the laboratory. The differences between the living birds are shown in stance, action, voice, and in particular habits." The material he intended to review, he explained, could be divided into the following groups, each with well-defined ranges:

I. A large, light-breasted form breeding across the continent. Undoubtedly *B. c. canadensis.*
II. A large, dark-breasted form breeding on Queen Charlotte Islands and probably adjoining localities in Alaska; evidently *B. c. occidentalis.*
III. A medium-sized, light-breasted form breeding in the northwest. The bird hitherto generally called *B. c. hutchinsi.*
IV. A small, dark-breasted form said to breed along the east coast of Bering sea, *B. c. minima.*
V. A small, light-breasted form breeding in the eastern Arctics [sic]. A hitherto unrecognized race.[44]

At this point Taverner began a detailed analysis of the five groups starting on page 31 and continuing through page 39 of his study. This was a closely reasoned discussion of the problems encountered in trying to distinguish each of the five groups from the data available to him then. Rather than attempt to present a précied version of what Taverner wrote here, I can recommend his full discussion to the reader, since only by having it before one is it possible to follow the links, or lack of them, in their complex relationships. Moreover, the six tables providing the dates, places and names of the species together with their measurements, that are under discussion can best be understood when they can be studied in detail.

After ten pages of discussion Taverner summed up his findings as follows:

"The degree of relationship between these various forms of the genus *Branta* is difficult to arrive at. Though the breeding specimens under review show clear enough lines of demarcation between the groups, intermediates are said to (and probably do) occur. Whether these are true intraspecific intergrades or extraspecific hybrids is not clear."[45]

As a result Taverner's revision of the taxonomy of the Canada Goose in 1931 recognized the following species and subspecies:

| | |
|---|---|
| Canada Goose | *Branta canadensis* Linnaeus |
| Eastern Canada Goose | *Branta canadensis canadensis* |
| Western Canada Goose | *Branta canadensis occidentalis* |
| Lesser Canada Goose | *Branta canadensis leucopaeria* |
| Cackling Goose | *Branta minima* Ridgway |
| Richardson's Goose | *Branta hutchinsi* Richardson [46] |

Taverner was by no means satisfied with his study of the Canada Goose. In a letter to Rowan he said:

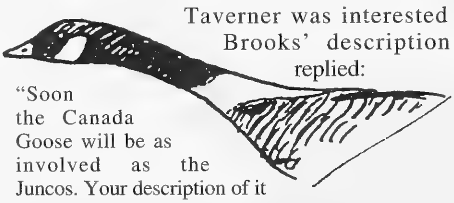
"Glad you like the goose paper. All I am uncertain about is the specific distinction of *hutchinsi.* I might have been better advised to have made it a subspecies of *canadensis* though I do think that *minima* deserves that (specific) status. Another question that I am not settled in my own mind about is the applicability of the name "*leucopaeria*" to the light breasted middle sized bird that we have heretofore called *hutchinsi.* However if one waited until they determined positively every side issue of so complicated a subject little could be accomplished. It was too bad that I should have to ball up the nomenclature so but there was no way out of it. Richardson's *hutchinsi* was not the bird that has been so called all these years."[47]

The Fourth Edition of the AOU "Check-list of North American Birds" (1931) disregarded Taverner's suggested changes to the species *Branta canadensis*. He was well accustomed by this time to doing his best as he saw it, and being patient.

In *Birds of Canada* (Taverner 1934) nine pages of print and three of coloured illustrations were allotted to geese inhabiting Canada, as well as seven black-and-white drawings by Taverner. In a short entry for Ross's Goose (*Chen rossii*) Taverner noted that its nesting location was unknown and information on its distribution was "problematical".[48]

Writing to Brooks, who was in California in the spring of 1933, Taverner said that he had heard from Grinnell who told him that Phillips, Moffitt, Swarth and Brooks had dinner at Grinnells', where they had a general discussion on the Canada Geese. Brooks and Moffitt thought there was still another goose to be named. Taverner agreed though he had no material with which to demonstrate his suspicions.[49] In reply Brooks agreed that there seemed to be another goose to be described and explained:

"It is known to the professional goose hunters of California and occurs in flocks of birds that all show the same characters — an intermediate size between — *leucopaeria* and *minima* with a brownish coloration and a wide white collar running to a point on the back. It has not the narrow blackish area below the stocking or white collar on the throat which is the very best characteristic of *minima*. Many specimens in the M.V.Z. [Museum of Vertebrate Zoology, Berkeley] & in Moffitt's collection. The former are labelled *minima* by Swarth. A range will have to be found for it before it can be described."[50]



Taverner was interested with Brooks' description and replied:

"Soon the Canada Goose will be as involved as the Juncos. Your description of it

"brownish" is like the type of *occidentalis* which is not mouse gray below but distinctly and pronounced reddish. I have always regarded it as a freak bird, — it does not seem due to rust stain."[51]

An important new development came when a brief paper by W. E. Clyde Todd, describing a new eastern race, was published in *The Auk* in 1938.[52]

When Taverner retired in 1942 he had been unsuccessful in discovering a new species of North American goose, though several of his fellow ornithologists had succeeded. However, in 1951 Jean Delacour proposed a new subspecies of Canada Goose be named *Branta canadensis taverneri* in his honour.[53] In his *Waterfowl of the World* he described its characteristics as follows:

"Resembles *B. c. parvipes*, but smaller, with shorter bill and neck, and generally darker, although very variable in colour, some specimens being as pale as *parvipes*, others as dark as *leucopareia*. It also resembles the latter closely, but it is generally larger and it has a differently shaped bill, less high near the base and broader towards the tip, with a smaller nail. The white neck ring is often lacking, and when present it is narrow or incomplete."

Under Distribution he wrote:

"Breeding areas as yet poorly known. Breeds probably throughout the interior, ten to fifty miles from the coast, from the base of the Alaska Peninsula to the Mackenzie River delta. It intergrades with *minima* in the Wainwright area, and with *occidentalis* in the south-west. It certainly also intergrades with *parvipes*, but the ranges and intergradation of the two forms are yet to be worked out. The identification of the various populations remains difficult, and until further knowledge is acquired we unite them under the name *taverneri*. Winters from Washington to Texas and Mexico, mostly in the large interior valleys of California."[54]

It was not recognized in the AOU Check-list of 1957, but it was included by W. Earl Godfrey in *The Birds of Canada* 1986.[55]

In this way Taverner received posthumous recognition for his years of work towards unravelling the species *Branta canadensis*.

With the temporary cessation of summer expeditions Taverner found that there seemed to be more routine work than ever. Writing to Brooks he complained "… one gets lost in detail … I am loaded with routine now as it is". In the same letter he admitted writing "over a thousand letters a year".[56] Meanwhile there was plenty of ornithological research to be done in the museum even if work in the field had stopped. There were records to be kept up to date, especially concerning the distribution maps. The information they contained was often required.

A letter from Leon J. Cole, professor in the Department of Genetics at the College of Agriculture, Madison, Wisconsin, to Taverner in 1932 asked if it was possible to obtain live Mourning Doves from the northern limit of their range. This, he explained, was for use in studies following the lead by Rowan, on the effects of periodicity of light in relation to migration and distribution of that species.[57] In reply Taverner sent Cole a rough copy of the museum's distribution map of the Mourning Dove, with a note that he had data on all the spots recorded on the map. For Ottawa he wrote: "The species is rather rare here … though I think slowly increasing yearly. It is more common at Kingston. Common throughout the lower peninsula of Ontario. In Manitoba north to between the big lakes. In Sask. to Quill Lake. In Alberta not quite to Edmonton. In southern B.C. and farther north along the coast."[58]

Before discussing *Birds of Canada* (Taverner 1934) we can note an event that took place in 1928 when an edition of 3000 copies of sixty coloured postcards of birds was issued. According to the Museum Bulletin:

"The coloured illustrations were made from plates of "Birds of Western Canada," some from "Birds of Eastern Canada," and some from new paintings by Major Allan Brooks. Each card contains one coloured illustration, accompanied by descriptive text, and the cards are supplied in sets, in carton, for sale at $1, and also loose, for sale at two for 5 cents."[59]

The printing of the colours was good, and the descriptive text, including a little information on the habitat of each bird, was useful. The paintings by Brooks carried these "picture postcards" far above the usual standard of collectible cards. Their publication served as a trial run, both for the King's printer, and for the public which would get some idea of what to expect from a new Taverner-Brooks collaboration — this time dealing with all species of birds known to occur in Canada.

*Birds of Canada 1934*

The earliest official proposal to combine Taverner's two books, Eastern and Western Canada, into one large one was made by Collins to Camsell late in 1928. Taverner informed Brooks that Collins had agreed to Brooks making 35 new bird pictures for a book to be called *Birds of Canada* at $2.00 each picture.[60]

While Brooks and Taverner were working on the text and illustrations of the new book, and much ornithological correspondence was flowing between them, a timely development was taking place in the Royal Canadian Mounted Police. An RCMP officer, stationed in the Yukon, wrote to Hoyes Lloyd in 1933, explaining that he was fond of birds, but had no one to turn to for help in identification. He had managed as best he could by using Taverner's book "without which of course I could have done practically nothing". He added that by reading *Bird-Lore* he knew that Hoyes Lloyd was a bird-lover.[61] In October 1934 Taverner informed Collins that he had been told that the RCMP had officially applied to the Parks Branch for bird books to guide their officers in enforcing the Migratory Birds Act. They

were directed to obtain copies of the forthcoming *Birds of Canada*. In reply the RCMP said that it would supply each police post with a copy. Since there were approximately a thousand such stations manned, Taverner said that the museum could expect an order of that number. In addition Lloyd had told him that an order of about 500 copies in French and English from the Quebec government had been received.[62]

Much of the correspondence between Taverner and Brooks in these years was about the descriptive text of the *Birds of Canada*. Here is an example when Taverner told Laing:

> "I wish I could tell Wrights from Hammonds Flycatcher when I see them. Have no great confidence in the wing formula. They intergrade in this and if so why not overlap? Probably field observation is the best criterion."[63]

In *Birds of Canada*, under Wright's Flycatcher, he wrote that it was a little longer than Hammond's Flycatcher, and shorter than Traill's. Of general colour design of dusky-olive and white, like the Wood Pewee, but smaller. After a paragraph on distinctions and one on field marks he concluded, saying:

> "Very closely resembling the Least Flycatcher and Hammond's and the wing formula (Figure 398) is probably the best distinction".[64]

In 1935 Brooks was writing more about collecting skins for the museum and said that if Taverner required pelagic skins from the west coast Arthur Peake would work hard in collecting them, and added:

> "But for the Lord's sake send me a catalogue of what you *have*, here am I anxious to fill your gaps gratis and you will not take advantage of it! Species and plumages".[65]

*Birds of Canada* was a solid book of 445 pages, measuring 9 1/2 by 6 1/2 inches, and weighing about 3 lbs in the 1934 edition. It is too substantial to read in an ordered sequence, and it is best dipped into at random while enjoying the many coloured portraits of birds by Brooks and Hennessey. One way of sampling the book might be to read a page or two of descriptive writing about the following birds which can be recommended for reading for pleasure: Ruffed Grouse 156; Whooping Crane and Sandhill Crane 168-171; Killdeer 181-182; Long-billed Curlew 189-190; Eskimo Curlew 191; Willet 195-196; Peeps (small sandpipers) 201-202; Hudsonian Godwit 209 "a fine bird on the verge of extinction"; American Avocet 211; Wilson's Phalarope 213; American [Eastern] Screech Owl 257; [Common] Nighthawk 268-269 — the good they do; Calliope Hummingbird 275; Black-capped Chickadee 311-312 — "their shape, a round bundle of feathers with long tail and no appreciable neck, and contrasting face marks"; House Sparrow *Introduced* 366-368; Bobolink 368-369; Western Meadowlark 370; Yellow-headed Blackbird 371; Redpolled Linnet [Common Redpoll] 388-389.[66]

*Birds of Canada* was very well received by reviewers and the general public. J. Grinnell reviewed it so warmly in *The Condor* that this has been reproduced fully here:

> "A truly beautiful as well as useful book is P.A. Taverner's new 'Birds of Canada' ... While in a general way a combination of the author's previously published two volumes, Birds of Eastern Canada and Birds of Western Canada, the text has been entirely rearranged and there is much new information. The abundant colored illustrations are chiefly from the brush of Allan Brooks, while most of the line drawings are the work of the author. The subjects of these latter are well chosen to show important structural or field characters of species; indeed, some points are thereby brought out that we do not recall having seen portrayed or even mentioned in any other work. Cooper Club members living in the northwestern United States will find this book, we think, quite the best single volume to own as a guide to their local bird-life. General topics and questions of the day are dealt with in Taverner's well-known common-sense way; and they apply south of 'the line', as well as north. The book was written with the aim of stimulating 'an interest, both esthetic and practical, in the study of Canadian birds.' It must surely fulfill this aim. — J.G."[67]

The review by W. Stone in *The Auk* contained a few mild criticisms but otherwise referred to it as an excellent work which would do much to advance ornithological interest in Canada.[68]

In Britain it was reviewed by W. L. Sclater in *The Ibis*, who had nothing important to say since he knew nothing, at first hand, about the subject. However, the last sentence of his review was encouraging to potential readers:

> "It has, moreover, one supreme merit, it can be obtained for the trifling sum of two dollars (about nine shillings), a remarkable price considering the coloured plates, which are eighty-seven in number."[69]

Taverner's many black-and-white illustrations were also well received. One writer for a Montreal newspaper congratulated him on the illustrations throughout the book. Replying, Taverner said that he considered Brooks' work outstanding. As regards his own he said:

> "Of course my little pen and inks are only hammer and tongs draughtsmanship. I do them because it is easier to do them myself just when wanted than to tell some one else just what I want."[70]

Just at the time when Anderson was mounting a campaign to ridicule Taverner's ornithological knowledge and ability something very heart-warming happened to him. He received a letter notifying him that he had been elected Fellow of the Royal Society of Canada, and asking him to send the Secretary a note on his academic degrees. Even when about to be awarded an honour Percy Taverner was faced with the unpleasant fact that he had no academic degrees to support him. But he made the best of the situation in the following letter to the Secretary of the Royal Society of Canada:

"Dear Sir:-

I take great pleasure in acknowledging your notification of my election as Fellow of the Royal Society of Canada and assuring you that I appreciate the honor.

Unfortunately I have no strictly academical degrees but am Fellow of American Ornithologist's Union and Colonial Member of British Ornithological Union both being elective and of some distinction in ornithological science.

I hope to be able to attend the May meeting at Hamilton to be presented in person.

My full name and address as below.

Sincerely,-

Percy Algernon Taverner,
National Museum of Canada,
Ottawa." [71]

*Raptor Control*

Taverner tried to keep on friendly terms with as many naturalists as possible because, as chief ornithologist at the National Museum, he wanted all the information and cooperation he could get from interested people. But there were a number of contentious issues in which he could not help becoming involved. One such was the argument, which broke out in 1923, about whether it was necessary to control "vermin" in bird sanctuaries. This was sparked off by an article by J. A. Munro published in *The Canadian Field-Naturalist*, followed by an editorial answering it. Two long and peppery letters appeared in a later issue — one by Rowan and one by Brooks, and two from ornithologists in the United States. These contributions were discussed in a second editorial.[72] As a result of this opening fusillade more supporters got into the fight on either side. In the west Brooks and Rowan squared off with Munro, in the east Jack and Manly Miner, together with E. R. Kerr, wrote strongly-felt letters about the necessity of destroying the following vermin: Great Horned and Barred Owls; Cooper's, Sharp-shinned, Red-tailed, Red-shouldered, Marsh [Northern Harrier] and Sparrow [American Kestrel] Hawks. Crows at all times. Harkin, as Commissioner Dominion Parks Branch, and Hoyes Lloyd as Supervisor Wild Life Protection, together with W. E. Saunders bore the brunt of some lengthy letters from Kerr and Manly Miner.[73] Taverner, although he was tryng not to take sides, also became involved when Manly Miner wrote the following, as from his father to Harkin, as part of a long handwritten letter [uncorrected]:

"I would like to see Mr. Percy Taverner and Mr. W. E. Saunders go to a crows nest and a few days before young crows fly some evening shoot the young crows and examine their stomach. They will not only find yokes of eggs but they will also find shells of song and insectiverous birds eggs in the crows stomach. Why I say Mr. Taverner and Saunders I don't think Canada can produce two men who have examined any more birds stomachs than these two men and have had years of study afield."

Manly added a rather imperious P. S. without, perhaps, realizing its implications:

"Read this to Mr. Taverner and Gibson and then please forward to Mr. D. McDonald, Deputy Minister of Fish and Game, Toronto. I want to keep these men informed and as I have no typewriter, it will save me writing 3 more letters."[74]

Was the Commissioner to send for Taverner and Gibson to come to his office, and then read this long-winded letter to them while they earnestly listened?[75] The following day Kerr wrote again to Harkin, thanking him for his letter, and for a copy of a letter from Taverner to Harkin. Kerr said that crows were 85% predators and harmful and should be destroyed. "I am not prejudiced, but positive". He then turned to deal with Taverner.

"Like all ornithologists, Mr. Taverner waxes evasive when discussing hawks and owls during the winter months. I still claim all hawks and owls with us during the winter are predaceous and do more harm than good."

Later in the same letter he wrote that ornithologists had no interest in sports or sportsmen, therefore their writing and views had no appeal to sportsmen.

"Possibly, of all of the ornithologists I have come into contact with, directly or indirectly, Mr. Taverner and Mr. W. E. Saunders seem to be the most open minded of them all, and these men may possibly make more headway among sportsmen and farmers if they will try to agree that hawks and owls of all kinds with us during the winter are more harmful than good and should be treated accordingly."[76]

Taverner had been in touch with Manly Miner regularly in the past few years, and remained an active correspondent. Writing in February 1926 Taverner began:

"I notice from a number of sources that you are killing quite a number of hawks and owls at your place this winter. I do not want to take up the subject of the advisability of killing all these birds for the sake of a few admittedly bad ones but I would like to ask you when they are killed if you would not send them to the Canadian National Museum here at Ottawa. It seems too bad to waste them, why not let them do as much good here as specimens to balance a little of the evil they may have done in life?"

He ended the letter with a P.S. "I note a common reference to Cannible Birds. [This was a term that Jack Miner used.] 'A bird must eat its own species to be a cannible'. An owl that eats a quail is no more a cannible … than we are cannibles when we eat cows…"[77] Manly wrote asking if he had seen the letter about the crow controversy that he had written to Harkin. Taverner replied that it was an old controversy, that he had been anti-crow consistently, but the problem was that the crow had not been seriously investigated in Canada. "There is no exact information as to its status", he wrote. Later in the letter he said that he had received a copy of the editorial in the Kingsville paper and continued:

"Now its conclusion I personally think is correct but it is so full of errors, half statements and silences that if I had not already made up my mind as far as I can without a thorough investigation that I would class it with other floods of selfish propaganda we have been flooded with

since the war and would incline to the other side of the question.

Calling the Crow an Arch-fiend is absurd. He eats what there is to hand as is necessary to his existence, — just as we do. I suppose that some may say that you and your father are quite devilish because you prevent honest Hawks, Owls and weasels from making a living in the way the Lord intended they should."[78]

This correspondence continued for another thirty letters to the end of 1926, each man trying to put his own point of view in the best possible light. At the same time Taverner and Manly wanted to remain on reasonable terms because each had things to gain from the other, as we shall see.

On 20 April the Miners tagged 240 Canada Geese. Taverner, thanking Manly for his letter with this information, which reached Ottawa the next day, said:

"Glad you have banded so many geese but I do wish you would use a regulation tag that could be recognized after you and your father have gone or have forgotten about the details. I think you are missing an opportunity to make good work better."[79]

Manly's answer to this was:

"Re our tags on geese. We have our Post Office address and date on tags and then we keep a record of how many are put on at each catch and so forth. I think the regulation Biological Survey tags should adopt our plan because we get more or as many reports from tags that we didn't put on which we send report on to Biological Survey [sic]."[80]

During the summer of 1926 Taverner was busy with field investigations in Alberta, and in the autumn with the AOU meeting in Ottawa (see Chapter 13). Their correspondence on crows, hawks and owls in relation to bird sanctuaries resumed again in November, when Taverner wrote that he approved of Manly's policy regarding hawks in their sanctuary in winter. The Sharp-shinned, Cooper's and Goshawks were certainly "bad actors", and a bird or game sanctuary was no place for them at all. That a few of the large Red-tails and Red-shoulders should suffer accidentally while the others were being controlled could not be helped, but Taverner advised padding the traps' jaws to eliminate as much damage as possible.[81] Taverner realized that even the Red-tails and Red-shoulders might indirectly cause some harm by the disturbance they make, but he would judge this of secondary importance.

"Personally I am rather fond of birds of prey, and have a very real admiration for their bold, free ways, bravery and hardihood. These traits are admirable in men why not in birds, beasts. We can admire an enemy even though we have to control him for our own welfare. But I would not protect even hawks at too great a cost to other birds any more than I would eliminate all hawks for the sake of those birds. There is a middle course and … in all things the middle course is the right … way between two fanatical extremes. It is the hardest course to follow too."[82]

Ever since Taverner had come to know Jack Miner, and soon after through correspondence with his letter-writing son, he had been trying to steer the Miners away from a violent attack on hawks and owls of all species. A reading of the full correspondence between Taverner and Manly in 1926 shows that although he struggled to convince Manly not to harm them, this was impossible. Jack Miner's mind was firmly made up about the "wickedness" of hawks and owls, and his almost divine duty to exterminate them. All that Taverner could do was to try to mitigate the worst Miner excesses.

Hoyes Lloyd, likewise, in his official position as "Supervisor", Wildlife Protection, could do no better. In a letter to Taverner of December 1926 he wrote:

"In connection with your coaching of the Miners on ornithological subjects you may have an opportunity some time to call their attention to the fact that the banding of birds with authorized numbered bands is desirable. The Miners do not hold any Permit allowing them to band birds for scientific purposes and of course no such Permit can be issued unless they use authorized official bands … The Miners' work has been of such a calibre that this point on banding has not been raised officially and personally will not be raised officially so long as Jack Miner lives."[83]

*Issuing permits for collecting birds for scientific purposes*

A subject which began with the passing of the Migratory Birds Convention Act in 1917 emerged again in 1926 when Lloyd wrote to Taverner for his opinion on the advisability of reducing the limit on the number of permits issued to collectors of birds for scientific purposes. Taverner answered with a seven-page letter explaining why a proposal to reduce the limit to two birds per species should not be adopted. In his last paragraph he explained that "the scientific investigator, working for the advancement of knowledge, should not be treated as a suspicious suppliant for special favor". He should not be subject to more interference, Taverner claimed, "than is necessary to establish his good faith and prevent others obtaining his privileges under false pretenses."[84]

However, by 1931 dissatisfaction with activities of certain local collectors in British Columbia exploded because of what was considered lax enforcement of the regulations by those responsible for doing so. Lloyd sent Taverner a copy of a letter addressed to the Parks Commissioner, Harkin, from a William N. Kelly of Vancouver. In this way Taverner became involved in a contentious issue. The nub of the complaint concerned a confrontation between Kelly, representing a number of local ornithologists, and Munro in his position as Chief Federal Migratory Birds Officer for Western Canada. Kelly stated that it was well known "in this district that collectors do violate the law and the ethics of professional work in ornithology …". He also made the accusation that the contributions of collectors "to scientific ornithological knowledge are not commensurate with the destruction

of birds taken to build their private collections." He told Harkin that he should not expect him to act as a public prosecutor and take on himself the duties that should be carried out by the Federal Bird officer. Kelly continued that he would not have to take on these duties

"if the federal bird officer was faithfully performing these duties for which he is employed and paid by other bird lovers *who are not obsessed by the desire to have a large collection.*" [emphasis added].

This was a dig at Munro who was known in the district to have a large private collection of specimens. After several more paragraphs telling Harkin very directly how his officers should perform their duties, the writer tried to make "the Ornithologist of the National Museum" appear incompetent.[85]

Such a forthright letter caused problems at the Dominion Parks Branch. Taverner was sent copies of the correspondence by Lloyd, and replied to some of Kelly's points as follows:

"The collection of specimens is absolutely necessary for any sound study of ornithology.

That no institution or private collector can possibly collect in all the localities that it is necessary to have specimens from. It will have to rely on collectors elsewhere to supply its needs.

That the person who satisfies these needs is doing a public service just as much as he who supplies any other other human need and as such is entitled to a living remuneration therefore.

Whatever knowledge we have of birds of Canada, North America and the world has been almost entirely through the collecting ornithologist."

As regards the figures of the total bird mortality in B.C. given by Kenneth Racey in an article in *The Murrelet*, which Taverner considered authentic, and Kelly considered doubtful, Taverner produced a rather weak answer. In his final paragraph he tried to turn the tables by saying that when Mr. Kelly and his co-thinkers could add some new and original information to ornithology "we will respect his views more".[86] In a letter to Harkin, in answer to his enquiring about the help that collectors under the permits issued by his department had been to Canadian ornithology, Taverner replied that eighty percent of the observations made by amateur ornithologists unsupported by specimens or by familiarity with specimens contained an element of doubt. On the contrary, the work done by such collecting ornithologists as, — Allan Brooks, J. A. Munro, K. Racey, H. M. Laing, G. C. Harrold, Wm. Rowan, Ronald M. Stewart, L. B. Potter, W. E. Saunders, Robie Tufts, Gus Langelier, and a host of others in Canada and the U.S. could hardly be estimated. In all these, thanks to specimens collected and to familiarity with specimens, all element of uncertainty was practically eliminated. Taverner continued to give further examples, finally concluding that much current ornithological work was correcting errors made in the past by accepting evidence unsupported by specimens. Taverner had made a strong case for "scientific collecting", but the gist of Kelly's case was against commercial collecting being justified under the guise of permits for scientific collecting.[87]

When Taverner and Laing were carrying out field work at the invitation of Brooks, in 1922, they stayed at the foot of Vaseux Lake for a short while. Their nearest neighbour was a friend of Saunders' by the name of Parham. (See Chapter 12, notes 86 and 94.) In November 1932 Taverner received a letter which began:

"Dear Sir,

I have not, like my brother, the pleasure of knowing you personally, but your book, "Birds of Western Canada", has been by my side to guide me ever since its publication, and it is owing to the Introduction therein that I now write to you. On pages 16 and 17, under the headings "Bird Study" and "Permit Principles", some very good and useful advice is given. With this your fellow bird-lovers cannot seriously disagree, even though many of us wish that the regulations allowing the killing of non-harmful birds could be more severely restricted."

The author was H. J. Parham, who came to British Columbia in the 1890s, making his home at the foot of Vaseux Lake for eleven years. When Taverner was there he had already left. The gist of his letter was that he, and others, were not satisfied with the Government's part in the protection of birds. There was a general feeling, he said, that the Department's representatives were far more interested in the "collection" than in the "protection" of the rarer birds. He realized that these matters were not connected with the Museum, but he appealed to Taverner to do all he could through the proper authorities to ensure that the Department itself should carry out the spirit of the "principles" it set out for others. He ended by saying that the warden at Vaseux Lake, S. J. Darcus, had recently been dismissed, though he was a man "who was known to put the "protection" and study of the living bird first and foremost."[88]

Taverner was now "put on the spot" and had to repeat what he had written to Harkin, but in much more detail, which must have taken up a fair amount of Taverner's time. In his answer he took up Parham's arguments point by point: Parham had exaggerated the effect that the scientific collector had on bird life in general; that ornithologists need to collect specimens; that the conservationist is ineffective without the special knowledge that the scientific ornithologist alone can give. He finished this six-page letter with the information that he heard from the Parks Branch why Mr. Darcus was laid off — that it was due to economic retrenchment. He ended by saying:

"If the general public were half as interested in controlling the unsportsmanlike hunter as they are the unscientific or unethical collector most of the worries of the conservationist would be over."[89]

Parham's reply was sharp and swift. He repeated that the public was convinced that some of the

Number 897 17th day of March 1931.

DEPARTMENT OF THE INTERIOR

NATIONAL PARKS OF CANADA

# PERMIT

## TO CAPTURE MIGRATORY BIRDS FOR BANDING PURPOSES

(Subject to the Migratory Birds Convention Act and Regulations)

Permission is hereby given to Mr. P. A. Taverner, Ornithologist, National Museum of Canada, Ottawa, Ontario, under the authority of the Migratory Birds Convention Act to TAKE or POSSESS in the PROVINCE of MANITOBA specimens of each or any migratory game, migratory insectivorous or migratory non-game bird for banding purposes only.

This permit is to be signed by the permittee and shown on demand of any authorized game warden or police officer. It is revocable at any time at the discretion of the Minister of the Interior, and does not give any rights to take, injure, molest, or kill birds on any Dominion or Provincial game preserve or bird sanctuary.

This permit does not confer the right to take specimens of Whooping Cranes or Trumpeter Swans.

This permit expires 31st December, 1931.

Signature of Permittee

Hoyes Lloyd
For Minister of the Interior

Under the authority of the laws of the Province of MANITOBA

I concur in the issue of this permit.

Countersigned A. G. Cunningham
Director of Game and Fisheries.

Permit to capture migratory birds for banding purposes only in the Province of Manitoba to Mr. P. A. Taverner for the year 1931. Signed by Hoyes Lloyd on behalf of the Minister of the Interior, and countersigned by the Director of Game and Fisheries, Province of Manitoba. Note that this permit does not confer the right to take specimens of Whooping Cranes or Trumpeter Swans.

employees of government were given, in addition to their salaries, "the right to collect all the rare and beautiful birds that they or their subordinates care to kill, in order to set them up, and sell or trade them." He gave as an example, two or three collectors whom the Provincial government sent to the Okanagan Valley during nesting time to collect all the female Lazuli Buntings they could. The result, he said, was that these beautiful birds were never so plentiful again at Vaseux Lake. Taverner's figures regarding area and bird population, he said, seemed to be mistaken for British Columbia.

"Your fears for the continuation of ornithologists are, I think, groundless. I find a dozen enthusiasts today where there was one in the old days, and no doubt a few of the younger generation will turn to the scientific side."

He said that "we" realized the need for such men as yourself and my old friend Allan Brooks to have new specimens from time to time, and we know how much you two have done through publications to make bird-study popular.

"But the scientific 'spade work' has already been done, and the garden can be kept in order by a few experts."

He then went into the treatment of Darcus in more detail.[90]

Taverner was clearly upset by Parham's second letter and said so, answering all of his arguments in detail. As regards Mr. Darcus, Taverner said that there may well have been some political influence involved since these minor posts were not under civil control. Local members often had wide powers in their appointment.

"As long as the people of Canada will stand for political patronage and 'to the victors belong the spoils system' departmental authorities are helpless in such cases. No system of appointment is perfect and the Civil Service has its grave faults but at the worst it cannot be as bad as the political spoils system that is its only alternative. But if the people of Canada stand for it the results are their own fault."[91]

On the final page Taverner tried to be conciliatory when he wrote:

"You say that the spade-work has been done and there is little use for the expert any more. To the superficial observer perhaps it so appears so but to me who am studying the country as a whole and in detail it looks as if little more than the ground was scratched. What we do not know of the Birds of Canada is enormous, I am continually running up against the unknown and having to dodge here and there to make up for ignorance.

I do not hope that I have convinced you altogether but I expect that at least I have shown that there is something to be said on my side."[92]

Parham was not easily put off by answers from Taverner or Harkin. In March 1936 he sent a copy of a chapter of a book that he was writing under the title *A Nature Lover in British Columbia* to Harkin, Commissioner of the National Parks Bureau. Parham was told that next time a senior officer was going to British Columbia he would call to discuss the question with him. When, after a year, no one called, Parham went ahead and published the book with the chapter on saving the birds in it. Taverner's argument that uncommon birds still needed to be collected was brushed aside, and a new menace to sea birds was included as follows:

"The important facts concerning practically all our inland birds are now known; and although there is still much to be found out about bird-life, this does not call for the slaughter of any more uncommon birds. Observation, photography, and banding should now be the ruling methods.

Bird-lovers should also make every effort to get their Governments to deal with the constantly increasing menace of fuel oil upon coastal waters, for this is taking a terrible toll of life amongst our sea birds."[93]

This was a loud warning about the damage being caused to sea birds by the loss of fuel oil from tankers along Canadian coastal waters in a book published as far back as 1937. Too many oil tankers were handled irresponsibly then, and now, over 50 years later, still are.

An unsigned review in the *Ottawa Journal* (1938) was obviously written by someone with knowledge of the controversial subject, and was in the nature of a public reply by the Parks Bureau to Parham. Two columns were devoted to explaining how bird protection was carried out by the Dominion Government under the Migratory Birds Convention Act, and the regulations made under its authority. The chief migratory bird officer in British Columbia, the review said, was Mr. J. A. Munro who had held that office since 1920, was an ornithologist of international standing, author of many brochures and scientific studies and author of a popular handbook on birds which was distributed to all the schools in British Columbia. The administration of the Migratory Birds Act came under the National Parks Bureau of the Lands, Forests and Mines Branch of the Dominion's Department of Mines and Resources. Officials of that bureau, the review continued, had complete confidence in Mr. Munro, and were of the opinion that Mr. Parham's criticism was unjustified. The reviewer explained the difficulties under which Munro worked.

"Mr. Munro has no permanent staff. He has seasonal assistants at small salary, works in co-operation with the Mounted Police and the provincial game warden."

The remainder of the review discussed in some detail the issuing of scientific permits in relation to the law. These permits could only be granted "on the issue of a permit by the Minister or by any person duly authorized him him". Permits were not issued by Mr. Munro or any field officer, but only by the Department in Ottawa. In the latest year for which figures were available, in all British Columbia only fifty such permits were issued, and only about 1500 specimens were reported taken by them, with each permit a printed code of principles, three sections of which were quoted verbatim. This part of the article contained useful information on the regulations covering the granting of scientific permits at that time.[94] But it did not answer Parham's complaint. His point was that the Department's representatives were more interested in the collection, rather than the protection, of the rarer birds.[95]

## CHAPTER 16. The Widening Field of Studies II, 1936-1942

*Taverner and some museums in Canada*

Taverner tried to keep in friendly contact with the curators and ornithologists at other museums across Canada. Francis Kermode, director of the Provincial Museum of British Columbia in Victoria, and Taverner kept up a spasmodic correspondence. But owing to the hostility of Brooks towards Kermode, Taverner had to step carefully.[1]

In the prairie provinces there was little of importance to involve Taverner in Edmonton or Calgary.[2] In Saskatchewan, Taverner was regularly in touch with Hedley Mitchell, preparator and naturalist at the Provincial Museum of Natural History in Regina from 1913 onwards.[3]

In Manitoba, a Natural History Society was formed in 1920, and the question of a permanent public museum was raised. A museum Committee was appointed, the members being B. W. Cartwright, A. G. Lawrence and Dr. H. M. Speechly.[4] With the sad death of Cyril Harrold in 1929 the question arose of how A. P. Harrold should best dispose of his brother's personal collection of birds and eggs. Taverner wrote asking him what he intended to do. He replied he was planning to give the collection to Winnipeg.[5] Meanwhile Cartwright and Lawrence wrote an appreciation of Harrold and sent it to Taverner for publication in the *Canadian Field-Naturalist*. In reply Taverner said: "A. P. Harrold tells me that he is giving the collection to Winnipeg. I must confess I knocked the idea pretty hard." This was not for any personal reason. The more reputable museums there were in the country, Taverner felt, the more cooperation they would receive, and the better they would sell the museum idea to the general public which will be to their great advantage. He continued:

> "But a museum is a continuing and established organization more than it is a room in a building or even a set of exhibition or storage cases. We who have watched these things carefully have every justification to be pessimistical over small local museums started with the enthusiasm over some local collection. The country is strewn with their wrecks and what is worse, — the waste of specimens that might have been of good use."[6]

Taverner felt that wildlife specimens, even in collections under University administration, had an uncertain future. Few university professors had any lasting interest in museums. He had recently seen a ghastly wreck of a rather ambitious museum at Queen's University. Taverner would rather see Harrold's specimens in Cartwright's or Lawrence's hands personally than suffer the almost certain neglect that would come as soon as Harrold's immediate friends had died and the early enthusiasm was over. "Harrold himself felt just as I do about these things", Taverner wrote, "and had very little faith in these small amateur museums". He then gave his frank opinion about the best way to proceed.

> "If Manitoba or Winnipeg is going to have a real Museum I greatly rejoice but the essence of a museum is a skilled staff and an assured future and to start off without them is more likely to postpone a real one than to be the nucleus of a future one."[7]

In 1932 space for a museum was set aside in the newly-built Winnipeg Auditorium, and the Manitoba Museum Association was set up to operate the museum which was opened in December 1932. Dr. Speechly became President of the Association. Meanwhile Taverner was keeping a watch on the development of the museum through letters from Cartwright, until Cartwright joined Ducks Unlimited as Chief Naturalist in 1937. Subsequently Lawrence kept Taverner informed about events in Winnipeg. Writing to Speechly, Taverner said the greatest need of a young museum was for experienced curators. Every library of any pretention expected its librarian to take a course in library work, he wrote, but when it concerned a museum any one was considered competent to direct it. Yet running a museum was a more complicated matter, and consisted of much more than sticking specimens in cases and on shelves. Taverner made the following proposal.

> "Now it is proposed that we in the National Museum where we have a considerable and varied staff of experienced museum men, the National Art Gallery and perhaps the Archives unite in giving a short course in museum management, objectives and methods, for the benefit of the struggling museums of the Dominion. The scheme is to induce the Carnegie Foundation to pay transportation in whole or part of selected applicants. The course will be free. What do you think and would any of your people be interested?"[8]

The Carnegie Foundation gave the museum two grants for cases and exhibits.

In December 1939, Speechly sent Taverner a Christmas card and a note about the museum growing slowly. In reply, Taverner said it took about thirty years for a new idea to germinate and come to fruition in the public mind. Speechly had mentioned about 2000 visitors yearly in attendance. Taverner commented that when the children of these 2000 had passed through the museum age, he could expect some reaction from the public. Taverner warned Speechly, and by extension the members of the Manitoba Museum Association and the Honorary Curators and Assistant Curators, not to lose heart. He continued:

> "The idea that cultural values are equally important with economic may then be in process of seeping through the general consciousness … Getting adequate support of a museum is up-hill work until the value of it is grasped by the electorate of the legislators who open or close the purse-strings. Don't lose heart for the next thirty years and don't let the idea die or else it has to be done all over again."[9]

In the spring of 1940 Taverner received a copy of a talk on museums, given by Speechly, and sent to

Taverner from the National Gallery. After congratulating him Taverner turned to the state of the National Museum.

> "Our Museum also has been going steadily downward for many years, — almost since its inception and under present conditions there seems little hope to stay the continuing process. With all the investment in it from a purely financial standpoint it seems absurd that it should be allowed to lapse yet that finish does not seem too far away. All we can do is to hope for better things but I sadly fear that we Canadians are not museum minded and are more interested in material than in cultural things."[10]

During the 1930s Taverner had given considerable thought to the role of museums in society. In 1934 he gave two radio talks on CKCO Ottawa. The first was "The study of birds as a cultural pastime" (12 January 1934); the second was "The what, how, and why of a National Museum" (6 April 1934). There appear to be no letters of comment on these talks preserved in Taverner's official correspondence, though there may have been among his private papers which were not preserved.[11]

The largest ornithological collection in Canada after the national collection was that of the Royal Ontario Museum of Zoology (ROMZ) in Toronto. Taverner heard about the ROM both before and after its founding in 1912 from J. H. Fleming, but it seems that not until 1923 did a member of the ROMZ's staff get in touch with him. Then Lester Snyder, at that time technologist in ornithology, wrote to him for advice on what birds to look for during summer field work in the Lake Nipigon area. This was a good opportunity for Taverner to develop a useful link with the ROMZ. Taverner replied that he should look out for Connecticut and Kirtland's Warblers, Evening Grosbeaks and Sharp-tailed Grouse, among others.[12]

The two men first met at the AOU meeting in 1924. When Taverner realized that the ROMZ had started a regular series of expeditions to parts of Ontario he made some kind of verbal agreement that the ROMZ would undertake field work only in Ontario, and the National Museum would concentrate on other parts of the Dominion.[13]

In 1926, Snyder wrote asking for advice on rearranging the ROMZ study collection, and how to start a registry. Taverner replied with a detailed description of his system. In 1928 Snyder told Taverner that the Lake Nipigon faunal report was ready for publication in the *Proceedings of the Canadian Institute*, and he hoped to have the Lake Abitibi report done in the same way. An interesting piece of information included in the same letter was that James L. Baillie was going to night school, and would be unable to collect at Long Point that summer. Instead, Snyder wanted Baillie to collect at Ashbridge's Bay where "recent developments indicate that this will be our last chance." In the same letter he reported that W. E. Saunders was in Toronto for a Brodie Club meeting and presented the records of the Great Lakes' Ornithological Club on behalf of its members to the ROM. Snyder added "Please accept our thanks for making our institution the depository of these valuable records."[14]

In 1931 Taverner was working on the Great Horned Owl, and several letters passed between him and Snyder about identification of the species in the ROM collection. In one letter Taverner said that some might be intergrades between *virginianus* and *subarcticus* but could not be intergrades with *occidentalis* which belonged to the southcentral United States. He told Snyder that the National Museum had

> "an unusual lot of summer and nesting birds from many localities. If we had some of the gaps filled we could speak with much more authority. We greatly need summer residents from Mackenzie, Keewatin, Ungava and the maritime provinces".

Snyder replied that Taverner's letter contained "much of interest to him on the general idea of subspecific variation."[15]

In 1932 the ROM published a booklet on the hawks and owls of Ontario. and a copy was sent to Taverner who replied that he liked it, and added "Am particularly pleased with the little pen and inks of Shortt's".[16] During 1933 Taverner examined the ROM specimens of gulls from Churchill, including "Kumlien's" and "Thayer's", and wrote with his comments. The Sharp-tailed Grouse was the subject of correspondence in 1934-1935, especially on the discontinuity of range of the dark northern form.[17]

In September 1939 Taverner wrote to Snyder about his trip to Berkeley and back, with Martha driving, and asked the name of the Toronto man who lugged about a big telescope and tripod at the AOU meeting. Snyder replied that he was Murray Speirs, and he was studying for a Doctor's degree at the University of Illinois.[18] At the end of the year in a letter to Snyder he touched on the "splitting systematists" and the blind way they followed each other like sheep. As an example he pointed to the water thrushes. A series of 125 specimens amply demonstrated to him that there wasn't such a thing as Grinnell's Waterthrush (*Seiurus noveboracensis notabilis*).[19]

Looking back over the careers of Taverner and Snyder in the 1920s and 1930s one can understand how much they helped each other. Taverner needed an expanding museum, relatively near to Ottawa, from which he could borrow skins for his studies of the Canadian races of species such as Canada Goose; Red-tailed Hawk; Great Horned Owl; Rock Ptarmigan; and Savanna Sparrow, to mention only a few. The ROM was the ideal place.

In return Snyder needed to be able to borrow skins for studying Canadian races of various species from the much larger collections in the National Museum. Snyder, especially in the 1920s, needed to be able to draw on Taverner's wide knowledge of bird distribu-

tion in Canada, and wide acquaintance with Canadian ornithologists. Both men needed a correspondent with whom he could feel at ease and discuss some of the problems of his professional work such as the administrative difficulties of museum work, the never-ending problem of correctly determining subspecies, and at times just "letting off steam". A useful symbiosis gradually developed between the two ornithologists. They had various things in common. Neither had a university degree though Snyder had majored in museum studies at the University of Iowa. Each man, towards the end of his career, suffered from a feeling of dissatisfaction with the museum in which he had spent his career.[20]

Another ornithologist at the ROMZ with whom Taverner had some correspondence was James L. (Jim) Baillie. Born in 1904 he was ten years younger than Snyder, joined the ROM in 1922, and began corresponding with Taverner on museum business in 1925. Writing to Taverner in 1926 he informed him that the ROMZ aimed to compile reliable breeding records of Ontario birds in order to establish the breeding range of each species in Ontario. He sent a rough plan of the proposed method.[21] Taverner replied that he had about half the Canadian species mapped out, and a card index of about 40 000 specific references. He suggested that Baillie should come to the National Museum in order to collect information from their records.[22]

Early in 1940 friends of Fleming were becoming anxious about the state of his health. Taverner wrote to Snyder asking to be kept informed. He said:

> "I am very sorry indeed to hear that Fleming is so low. I do not know what I would do without him. He has been my closest friend for so many years and ornithologically my chief mentor. But the situation looks alarming. Please keep me informed."[23]

Taverner saw Fleming for the last time when passing through Toronto in March. It could only be a brief visit because Fleming was very weak. He died on 27 June 1940. When Taverner heard the news from Snyder he replied, in part, "Fleming will be a great loss to us all, personally as well as ornithologically." After asking about the disposition of Fleming's considerable library, he wrote: "Well, I guess that this marks the end of an era in ornithology as in other things in Canada."[24]

When Taverner was asked to write an obituary notice for Fleming in *The Auk* he wrote to Snyder explaining that he did not feel that he could do justice in writing a tribute to his old friend. Snyder agreed to write it.[25] Taverner wrote a warm account of his early memories of Fleming for the Brodie Club's "Fleming Night" entitled "The Yonge Street Taxidermy Shop and Point Pelee Days".[26] In a letter to Snyder he wrote that the Fleming memorial number was a very fitting tribute, but could not help showing his disappointment at the lack of appreciation Fleming had received from Toronto during his lifetime.

> "It was a great regret to me that he did not receive the recognition from the Royal Society that he deserved, and it was the Toronto backing that failed him. Others got in who had done much less for their science than he did ... the trouble was he did not spout enough science jargon ..."[27]

In a letter a week later he told Snyder that they also had noticed the snootiness of Toronto that he had mentioned. Too bad Fleming was not University of Toronto though in that case he might not have been Fleming.[28]

A third member of the staff of the ROMZ whom Taverner came to know was Terence Michael Shortt, wildlife artist and display preparator. Taverner first heard of the brothers Angus and Terry Shortt from Cartwright in Winnipeg. Cartwright wrote about their artistic promise and sent Taverner a selection of their pictures displayed by the Winnipeg Natural History Society in 1928. Angus was then 21 years old, and Terence 17.[29] Taverner replied with a four-page letter of encouragement blended with critical talk on the basics of painting birds. This letter shows that Taverner had a fair grasp of the fundamentals. He spoke of the need for a good knowledge of the feather tracts and groupings. He advised students to do systematic drawing from nature "to place down just what they see, and to learn to see what is before them". Everything should be to the point, and the result of his own experience.[30] Cartwright replied that this was just the kind of advice they wanted.

> "They have been working on heads and wings, eyes etc. lately and are now giving feather tracts and pattern their attention. I have lent them Dwight's "Plumages and Moults of the Passerine Birds of New York" and they are of course getting in field experience at every opportunity. They have access to both Lawrence's and my own specimens so we are doing all we can with the meagre material at our disposal to help them along."[31]

The care that Taverner took in encouraging them was repaid by the rapid improvement in their work.

One other museum in Canada, with a fair collection of birds was the Redpath Museum in the grounds of McGill University, Montreal. The Redpath Library, a separate part of McGill University, has a superb collection of ornithological literature. Taverner first heard about the museum through Dr. Casey Wood, who asked his advice about the Emma Shearer Wood Library of Ornithology in correspondence which started in 1917 and continued irregularly into 1934. Wood was away from Montreal much of that time.[32]

Taverner had been in touch with the ornithologist Henry Mousley, of Hatley, in the Eastern Townships of Quebec, since 1914, and came to admire his studies of the breeding bird behaviour, and the home life of birds. In 1924 the Mousley family moved to Montreal, and in 1927 he was employed on library work in the Emma Shearer Wood Library where he remained for the next decade.[33] This gave Taverner a

useful link with the Redpath Museum, and an incentive to visit Mousley there when he could manage it. Taverner encouraged Mousley to publish his research in *The Canadian Field-Naturalist*, and they continued corresponding through the 1930s.[34]

*Taverner's Involvement with the American Ornithologists' Union in the 1930s.*

During the AOU meeting at Charleston in 1928 Taverner was elected to the Council. In a letter to Snyder he said: "The Charleston trip was delightful in every way … think the A.O.U. treat us Canadians very well indeed. I certainly appreciate the honor they paid me."[35] Another of Taverner's links with the AOU was his part in the very early development of bird banding in North America. In 1931 he sent Frederick C. Lincoln of the Biological Survey, Department of Agriculture, a list of the band numbers that he had distributed in 1905, 1906 and 1908 with the names and addresses of the recipients. He did not remember why no bands were issued in 1907, but guessed that it was for lack of funds "as I was living pretty close to the edge in those days and had to get the bands laboriously cut and numbered by hand". His record showed that some 429 bands were used, he said, in this early attempt. The system was essentially the same as that followed in 1931. Bands were issued by a central authority in single series, and records kept centrally. "As such I feel that if I am not the father of bird-banding [in North America], I am at least its grand-father".[36] Lincoln was glad to receive this information because such matters of historical interest should be properly recorded. He told Taverner that since the Biological Survey took over the work in 1920 well over 700 000 bands had been issued. With such a large number of birds wearing bands the Survey was receiving great quantities of returned information.[37]

When the fourth edition of the AOU Check-list was published in 1931, it received plenty of criticism. Taverner's friend, Frank Farley, criticized it on several counts, the main one being that the check-list committee did not make use of *The Canadian Field-Naturalist* for information on distributions. Taverner defended the action of the Committee. The making of a check-list of this size, he wrote, was a tremendous piece of work. To check all ornithological literature for distributions within a reasonable time would be impossible. The Committee had to draw the line somewhere, and they drew it at ornithological magazines. The *Canadian Field-Naturalist* was a general magazine so was excluded. On the other hand the galley proofs of the list were rather widely distributed, and suggestions from a large number of recipients were requested. Fleming, Brooks and Taverner "all had a whack at them", as Taverner put it. Many of their suggestions were adopted, in other cases they took someone else's opinion. The Biological Survey, he said, had an enormous amount of distributional data from all over America. The trouble was that they did not use enough discretion in how they employed it. "There is a bit too much Oberholser in that department" Taverner said, "and he is most credulous. A good many errors crept in that way." As to why there was no Canadian on the Committee, "there is no Canadian competent. We have good field men, good distributionists but no real systematists". After much more explanation along these lines, Taverner asked:

> "How can a Canadian bring any important assistance to a Check-list of the American section of the birds of the world when all he knows is Canadian birds and has no opportunity to learn North American birds much less those of the rest of the world."[38]

An important event in Canadian ornithology in 1932 was the holding of the AOU meeting at Quebec City. This was the first and only time in the history of the AOU that a bilingual program was presented. James Chapin of the American Museum of Natural History was fluent in French, and therefore played an important part in the program, especially in the French sessions during one afternoon. The business meeting was held at the Château Frontenac, and the public sessions were held in Laval University. The program was printed in English and French. During the business meeting Hoyes Lloyd was elected a Fellow. The election of officers resulted as follows: J. H. Fleming, President; Dr. Herbert Friedmann, Vice President; Dr. A. A. Allen to fill a vacancy in the Council. Other officers from 1931 were re-elected for subsequent years. This included Taverner as a member of Council.

The program included fifty-five papers covering a wide range of subjects. Palmer, in his report in *The Auk*, wrote that the outstanding contribution was "Sounds as an Aid in Bird Study" by Albert Brand, illustrated with moving pictures and slides, and reproduction of bird sounds on the phonograph. Improvement in outdoor recording, the method of editing film and the process of making bird sound records were briefly explained.[39] Although, due to his stammer, Taverner did not play any part in public speaking or in giving a paper, he exhibited some of his recent photography. Above all, being a sociable man with a good sense of humour, he was in the thick of the conversation with old friends and new acquaintances. One event that would have given him considerable pleasure was the evening when members of the Union were entertained by Dr. and Mrs. Gustave Langelier at their home at Cap Rouge, on the north bank of the St. Lawrence close to Quebec. Palmer wrote

> "… several hours were spent in looking over the Langelier collection of birds which is rich in specimens illustrating the various plumages of game birds and other local species and also contains a number of rare specimens, such as the Eskimo Curlew, Spoon-bill Sandpiper, Passenger Pigeon, and Carolina Paroquet."[40]

On 20 October members left by motor bus for Cap Tourmente about forty miles down the St. Lawrence, to see the Greater Snow Geese which stop for several weeks each autumn en route from their nesting grounds in the northeastern arctic Islands to the Atlantic coast from Delaware Bay to Chesapeake Bay. This was a great sight, a huge flock of about 9000 birds, feeding at close range, and then to see them rise, circle around, and slowly fly up the river to another feeding ground.[41] Taverner writing to Bishop pronounced the Quebec meeting a success, saying that Quebec was still largely "feudal" and could do things no other section could do. As regards the elections he said:

> "Oberholser was decisively beaten. I do not think that it will ever be possible for him to be elected president of the A.O.U. He has every scientific right to expect it and it is logical and just that he should have it but he has made too many enemies especially in his immediate circle where he should have his best friends."[42]

In 1933 the AOU Stated meeting was held in New York and celebrated the completion of the 50th year of the history of the Union. Taverner, in a letter to Brooks, wrote a fair amount on the AOU and the New York meeting. Here are two examples of what he said:

> "The people at the A.O.U. are a mixed lot, there is a good deal of the lunatic fringe. As men get older the more "sot" they become in their ways and the more intolerant they are. Quite a number show this effect in the A.O.U. Are we getting afflicted the same way? ...
> Of course New York is not a happy atmosphere for the A.O.U. The brass-hat attitude of the American Museum is not conductive to mutual understanding and I think was particularly evident this meeting. Also I feel that the comraderie [camaraderie] that used to be the key note of the A.O.U. is not as strong as it used to be. Is this because the Old Guard is dying out and newer more efficiently cold blooded men are more in evidence?"[43]

The third time that the AOU met in Canada was in Toronto, from 21-24 October 1935. The headquarters was at the Royal York Hotel. The public sessions were held in the theatre and lecture room of the Royal Ontario Museum. At the business session A. C. Bent was elected President for 1936. The Secretary reported a membership of approximately 2000. The program consisted of 67 papers. On the first morning L. L. Snyder spoke on "Ontario and its Avifauna", and J. L. Baillie on "The Bird Collection in the R.O.M.Z." Later in the program Fleming spoke on "The standing of Cory's Least Bittern, with an exhibition of specimens", and Taverner on "An outline of the *Buteo borealis* complex, with an exhibition of specimens".[44]

Members of the local committee decided to present some "awards" at the banquet to outstanding ornithologists. This is how Terry Shortt described it many years later.

> "... I remember that George Miksch Sutton received a huge whitewash brush. Hoyes Lloyd was given a toupé of the scalp of a Great Horned Owl complete with erect "horns" to cover his shiny bald head, (his comment: "I feel like the devil"). For Percy Taverner, author of *The Birds of Eastern Canada*, *The Birds of Western Canada* and *The Birds of Canada*, it was considered appropriate to complete the *tour de force*. Lester Snyder and I took a copy of *The Birds of Canada* to the technicians in the Museum of Geology laboratory and had them cut the book in two with their sophisticated equipment. It was cut horizontally. I made dust jackets for each of the halves entitling them "*The Birds of Northern Canada* and *The Birds of Southern Canada*. Taverner's comment on receiving these at the dinner ran something like this — a number of reviewers have torn my book to pieces but this is the *neatest* job that's been done to date."[45]

The edition of *The Auklet* for 1935 contained a spoof review of Taverner's *Birds of Canada* which read as follows:

> "To begin with, let us preface our brief comments on this work by stating that this hurts us more than it will Mr. Taverner. The author's book is nothing more or less than a fragrant case of plagiarism. We recall two publications, one on the 'Birds of Eastern Canada' and the other on the 'Birds of Western Canada', the authors of which we do not remember for the moment, both of which have been quoted verbatim! Mr. Taverner has apparently attempted to shield this fact by shuffling the systematic arrangement of the groups and species and by inserting a few distracting illustrations. The one feature of the book which appears to be original is that it can be cut in equal halves horizontally and one then possesses the 'Birds of Northern Canada' and the 'Birds of Southern Canada'.[46]

One person Taverner saw at the Toronto meeting was Bent, who was elected president for 1936. When he had settled into the routine of being president, Taverner wrote him a carefully thought out letter on how he saw the state of the AOU in 1935, and some suggestions as regards the future. Taverner had now been a member of Council for seven years and had every right, and perhaps duty, to offer the new president advice. The Union, he said, seemed on the point of making some radical changes, but how far they should go required some thought. They ought to keep in mind that the AOU was a scientific and not an emotional organization, nor a bird protection society. Taverner said he was pro-protection in every way but the AOU was not the proper medium for it. Also he considered the election of the position of fellow should be based entirely on scientific acquirements and not on protectionist activity. Next he gave his views on reforming the financial structure of the Union which, he said, was almost entirely in the hands of the Secretary and Treasurer and perhaps one or two other officers. "The rest of us Councillors are just dummy directors, and rubber stamp men." He concluded with a touch of humour when he wrote: "All of which is respectfully submitted which is the usual form of Civil Servants addressing their superiors".[47]

Bent replied that the AOU was primarily organized for the scientific study of ornithology but had

now grown beyond the interests of bird collecting and systematic ornithology into several other fields, such as bird photography, birdbanding, life history studies, etc. The vast majority of the Associate Members belonged to one of those classes, or were merely field-glass enthusiasts or bird protectionists, and the Union was largely dependent on their dues for support. Bent then stated his own position:

> "I am a dyed-in-the-wool bird collector and I have no patience with the growing tendency to refuse collecting permits, which is forcing us into 'bootlegging'; but what can we do about it? We are hopelessly outnumbered by the agressive protectionists and they are forcing us to the wall. The day of the private collector is about over."[48]

Late in 1936, when Taverner realized that Bent was shortly to reach his seventieth birthday, he wrote him a warm letter of congratulation at achieving so much for North American ornithology in his "Life Histories", and signed himself "Sincerely — your friend and Appletonian". In response Bent said that he had invited a few local friends to help him celebrate but he wished that all the Appletonians lived nearer.[49]

At this point the Appleton Club deserves mentioning. As a "club" it had no official membership and its activities varied from year to year. Ad hoc arrangements were made to meet in a separate room at times during an AOU meeting. Here they talked about birds, people and projects in a relaxed way, smoking and drinking with banter mixed with chat about AOU members not present. A word that appeared in Taverner's vocabulary in relation to AOU meetings was "camaraderie" in the sense of friendly good fellowship among equals, and seems to have been applied especially to Appletonians. Perhaps the main quality required was to be a likeable person, someone who got on well with others. A man such as Clyde Todd did not appear to have possessed this quality, perhaps because he was considered to be "unsociable". In short the Appleton Club was a useful network of men who got on particularly well together, and served a valuable function because they brought up matters which could best be discussed by a small, informal inner group in a non-competitive and non-hierarchical way.[50]

At the AOU meeting held at Charleston in 1937 Herbert Friedmann was elected president. After the meeting Percy and Martha drove down the east coast to Florida, the Keys, Cape Sable and the Everglades with two days at Lake Okechobee. From there they drove to Tarpon Spring, then inland through the mountains of Carolina, the Shenandoah Valley, New York State, and then via Detroit and Toronto to Ottawa. It was an exciting experience and Taverner returned home refreshed. During the months before the next meeting Friedmann made plans to put in motion "constructive leadership" in the AOU. Between December 1937 and September 1938 a series of letters passed between Friedmann and Taverner on the role and organization of the AOU.

Friedmann had a note in the spring 1938 issue of *The Auk* on new ideas on systematics and the Check-list. Taverner wrote to Friedmann on this subject, saying that the AOU should be directive as well as receptive, and that there were various lines of investigation that needed encouragement. For instance he suggested that certain issues of *The Auk* should be devoted largely to symposia on specific subjects. At the Washington meeting in 1938 Taverner asked why not have one session devoted to a particular subject that needed discussion. Why not invite papers on some controversial subject and publish abstracts of them in *The Auk*, in order to suggest lines of attack? Friedmann had already asked Taverner to head a subcommittee on North American faunistics. To this Taverner replied that he would be glad to serve on such a committee but doubted his ability as an administrator or organizer. Besides he was familiar only with the situation in the northern part of the continent.

The Fifty-Sixth Stated Meeting of the AOU was held at the U.S. National Museum, Washington D.C., October 17-22, 1938. During the business session three members of the Council retired after "long and valuable service": H. C. Oberholser, T. S. Roberts and Taverner. "Dr. Friedmann, Dr. L. Cole, Dr. Ernst Mayr and Mr. Taverner reported for the divisions of the Research Committee". Among the many interesting subjects of research was a symposium on the topic "The problem of the individual versus the species in bird studies". Among those speaking were: Margaret Nice, F. Lincoln and N. Tinberg. Friedmann introduced each subject.[51]

By now ornithology was in a state of change. Signs of this change could be seen in 1934 in Charles Kendeigh's paper "The role of the environment in the life of birds".[52] In a brief review in *The Auk* Witmer Stone picked out the salient points. The author considered especially temperature, relative humidity, solar radiation, food, precipitation and wind, and to a less degree biotic competition and physiographic features mostly in relation to the distribution, migration and abundance of birds. The physiology of the temperature of birds and their resistance to low and high air temperatures was discussed, based on experiments on House Sparrows. The paper also contained a special discussion of the distribution of the House Wren (eastern form) and the reasons for limitation on its northward distribution during the breeding season. In a final summary Stone reviewed the physiological processes in birds and the behaviour responses, and the factors controlling distribution, migration, abundance, and the role of animals in ecological communities.[53] Taverner read books and journals regularly, and corresponded with others, exchanging ideas and expressing his opinions. He never allowed his mind to vegetate. Here is Taverner late in 1936 in full spate in a letter to Bishop.

"Of course one trouble with the ornithology of today is that it is in a state of change. The obvious work of the old naturalists was purely systematic, discovering and naming new forms of life. A stock taking of zoological evidence. That has largely been accomplished. The evolutionary juice has been fairly well squeezed out of it now, and there are … many more would-be naturalists in the field all seeking new worlds to conquer and not knowing quite what to do. They are essaying all kinds of subjects, mostly up blind alleys. They are run through the university mill that turns out biologists not naturalists. They are physiologists, psychologists, pathologists, geneticists and microscopists, interested in what the animal is (mostly inside) but not in its relation to the outside world. The true relation between laboratory and field has not yet been worked out."

Taverner then went on to discuss systematics in relation to ornithology. The universities, he maintained, were wrong in thinking that systematics was a finished subject and that further work in it was unnecessary. For all ornithologists to confine themselves to the subject would be a great thrashing of old straw — there must still be a number of skilled systematists. Systematics needs to be kept up to date in zoology just as much as dictionaries are in literature.

"Just now all these young graduates are running around in circles chasing their tails in the endeavor to find something to do. The College professors don't know anything more than laboratory work with microscope and conditioned reflexes. When they direct their students to the field all they can do is to write theses on how many times a little bird wags its tail."[54]

In a later letter to Bishop he said:

"Ornithological methods are changing. Instead of equipment with field glasses and gun the present ornithologist peers through a microscope and draws graphs with long tables of how many times a little bird wags its tail. We are already back numbers."[55]

Taverner had been aware for several years that any ornithological research his contemporaries were engaged in was becoming outdated. This tended to affect members of the AOU — the old guard and the young gang. In a letter to Brooks of 1938 he commented:

"Ornithology has greatly changed since our youth, — many new fields are opened and some of the old ones neglected. That I am not interested in some of these fields does not prevent my recognizing some of their values but it is a pity that the old collecting naturalist is being so rapidly eliminated. We need not all be collectors but that phase should not perish from the earth." [56]

Friedmann, in his capacity as president of the AOU, wrote a piece on "The role of the A.O.U. in ornithology today" which was printed in *The Auk* in 1938. He explained that in its early days the AOU stimulated the work of bird protection and the popularization of bird study which gave rise to two organizations which long ago outstripped their parent — the Audubon Society and the Biological Survey. He stated that now the field of ornithological science was the AOU's remaining role, aside from publishing a quarterly journal, and various editions of the Check-list. Friedman ended with a call for the regeneration of the AOU.[57]

The effects of these changes in ornithology were very much on Taverner's mind at this period. Writing to Brooks he expressed it with acumen.

"The A.O.U. is not what it used to be and I quite understand why you and Bishop and others do not care to attend regularly. All the fine old circle is absent now. There may be others just as fine but they are of a younger strain and not as compatible. Also many of them are following strange gods and their ornithology is not what ours used to be. Since good old Kennard went the meetings are not what they were. We are old-timers."[58]

Writing to Rowan in 1939, in reply to a letter from him in which Rowan said that he hardly had anything more to do with birds "nowadays", Taverner said, among other things,

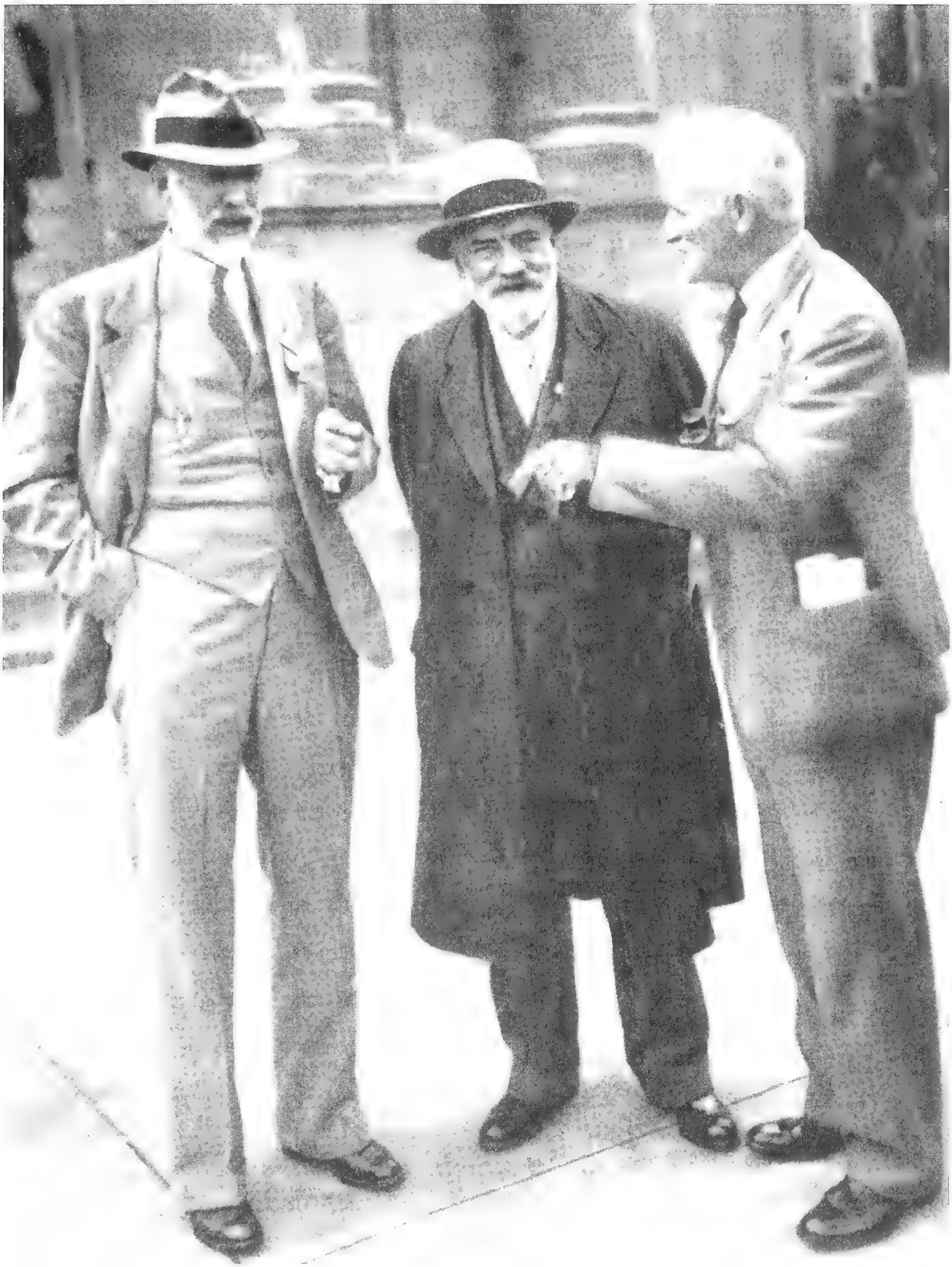
"Too bad you are losing your bird field work but I suppose that your university work does take up all your time. Too bad that none of our universities have such general natural history courses as at Berkeley and some other American universities. University Biology of the conventional type seems eminently adapted to smother all liking for living nature that cannot be obtained in a laboratory or viewed through a microscope. But it is too bad that Grinnell died. His death was a cloud on the A.O.U. meeting and I do not know how he will be replaced. He inspired many."[59]

By 1940 it was not just ornithology that had changed, it was the ornithologists as well, death was removing more and more of Taverner's contemporaries. Fleming's turn to go came in June 1940. Taverner, writing to Bishop with the news, sounded quite elegiac about it:

"One by one our contemporaries drop away leaving us alone amid another generation with which we have less in common. We become, not the Old Guard but the Rear Guard and perhaps camp followers. New ideals, new gods reign. Ornithology has changed since we arose, probably the development is good, but much of the contents of our journals are quite foreign to us and the leaders that are coming on know not Paul. It is inevitable."[60]

All that Taverner could do before someone was appointed to take over his post at the museum was to finish the research that he had been working on for the past few years, and his two pocket manuals.

At last, in 1936, Taverner was able to leave Ottawa early enough to carry out worthwhile field work. His first choice would have been to make an expedition north of Hudson Bay into the eastern Arctic. But for reasons of expense it was impossible. Instead he decided to make an ornithological survey along the recently completed stretch of the Hudson Bay railway from The Pas, Manitoba, to Churchill. He explained his reason for doing this in the "Annual Report of the National Museum" for 1936. The Ornithology of the Churchill area, on Hudson Bay, at the edge of the Arctic Faunal Zone, he wrote, had been well studied in 1930 by a museum party and by others since. In southern Manitoba, Taverner



W. E. Saunders (right) relating some experience to his old friends Taverner (left) and Fleming (Centre) at the American Ornithologists' Union annual stated meeting at Charleston, South Carolina, November 1937. Photo by A. F. Ganier (also appears on page 18 of *W. E. Sanders Naturalist*. Edited by J. R. Ruttes. 1949. Federation of Ontario Naturalists, University of Toronto Press). Reproduced courtesy of the Royal Ontario Museum Library and Archives; number 001225.

explained, the ornithological fauna, to the point where the Upper Austral zone influences begin to intrude on the Transition Life zone, was well known, but in the intervening territory little authentic information was available. He continued:

"The object of the 1936 work was to begin a direct line of consecutive observations between these two strongly contrasted faunas. The reconnaissance was carried south to Cormorant Lake within the drainage system and the water maze of the lower Saskatchewan River".[61]

Taverner was accompanied by R. W. Smith, of Wolfville, Nova Scotia, and T. E. Randall, from Edmonton.[62] They went to Churchill by rail and started their field work from there. The following account has been compiled from Taverner's field notes, reports and letters, and shows the names of the places they visited.

Churchill, mile 510 north of the Pas, head of the railroad and port at the mouth of the Churchill River on Hudson Bay. The next camp was at Herchmer, mile 412, at the crossing of the Owl River, 21 June – 2 July. While here Randall found 23 nests of the Harris' Sparrow which was breeding from Churchill south to Herschmer, but scarcely at all to the Limestone River farther south.[63] The subsequent camps were at Bird, mile 350, on the confluence of the Limestone and Nelson rivers from 3-17 July; at Ilford, mile 286, in the neighbourhood of Splitlake, 18-30 July; at Thicket Portage, mile 185, 1-31 August; and at Cormorant Lake, mile 42, 1-14 September. Although they travelled from one camp site to another by rail they did not remain by the railroad all the time, but explored various habitats farther afield. The beginning and ending of the field work happened at the Pas, mile zero, on the lower Saskatchewan River, 18-19 June, and 15 September.[64]

Although they did not collect a large number of specimens, Taverner felt that the results were distinctly worth while. For example, information on the comparative limitations of range of the thrushes was satisfactory. The Gray-cheeked Thrush was the only thrush observed at Churchill. Its range extended south to Herchmer. Here, Hermit Thrush were few, but at the Limestone river it was the only thrush. The Olive-backed [Swainson's] Thrush was not noted north of Thicket Portage. The northern limit of Wilson's Thrush [Veery] did not seem to extend north of The Pas. As regards White-crowned Sparrows, both the eastern race (*Zonotrichia l. leucophrys*), and Gambel's race (*Z. l. gambeli*) were "inextricably mixed south to the Limestone".[65] In the same letter to Brooks Taverner commented further on distribution:

"But I never saw birds so scarce and shy in my life as in this north. [American] Robins had to be stalked like hawks and then we were not able to get them at Herchmer. It took several days to get Song Sparrows that nested close to camp. Terns at Herchmer all seemed to be Arctics, at the Limestone all Common. The Solitary Sandpipers were interesting. The form at Churchill were definitely [*Tringa solitaria*] *cinnamomeus* [*cinnamomea*]. Only saw one and could not take it at Herchmer did not see it at the Limestone but [*T.s.*] *solitarius* [*solitaria*] was common at Ilford.

The boys worked very well. Randall is an inspired nest finder and collected a great number of eggs, Harris's Sparrow, L. [Lesser] Yellowlegs, White-crowns [sparrows] and a lot of other generally considered desiderata. His skin making was not of the best but he gained experience as he went."

Taverner continued that he was disappointed they did not get any downy chicks. He particularly regretted not getting downy Solitary Sandpipers. They nested commonly in the muskeg at Ilford, he said, but they just did not have the luck to find any good downies of them. Nor was it a good part of Manitoba in which to be working, as Taverner explained:

"We ran into insufferably hot weather for about two weeks, 98° in the shade which with mosquitoes, black and deer flies and bull-dogs [Moose flies?] made things difficult. We were fortunate in one respect however, a forest fire came straight down at us from 135 miles back and then stopped within 500 yards of our camp at Ilford."[66]

Taverner left Randall and Smith at Ilford to continue the work until mid-September.

In the summer of 1937 Taverner engaged Angus Shortt and W. Watkins, both of Winnipeg, to continue the ornithological cross-section of Manitoba from The Pas south as far as Duck Mountain. Taverner accompanied them for a month. They started at the beginning of June at Reader Lake in a sprucewood section a little north of The Pas; to Halcrow Lake south of the Pas 9-21 June; moved into deciduous and agricultural habitat near the town of Swan River 22 June-21 July; camp 4 was at Garland east of Duck Mountain 21 July-5 August; the last camp was at Singush Lake in Duck Mountain 5-27 August.[67] The main object of this field expedition was to establish the normal northern limits of range of various transition species and the southern limits of northern ones. Taverner did not type an account of the 1937 field expedition as he did for the previous year and, from his scanty ornithological information and analysis, it seems that the birds, from The Pas southwards, did not impress him. The orchids, however, seem to have been numerous, some of them being rather rare.

Angus Shortt, looking back fifty years to his experiences with Taverner, kindly sent me a resume from his field notes. In his covering letter to me he said "I remember Taverner fondly, as a knowledgeable and entertaining companion — humorous, considerate and an excellent cook."[68] Two anecdotes of Taverner as a camp cook follow. On June 3rd Shortt and Watkins got up at 6 a.m. to find it very cold. Luckily for them Taverner already had the stove going full blast in the cook tent, and was preparing bacon and eggs, when there was trouble. This is how Shortt described it.

Taverner photographing a Semipalmated Plover at Bird, Manitoba, on the newly constructed Hudson Bay Railway in 1936 (Reproduced courtesy of the Canadian Museum of Nature, number 81343.)

"Then we had uninvited company — tent caterpillars! Attracted to the heat of the chimney pipe, they were crawling down it in scores. Of course, when they reached a hot spot, they let go and came dropping down onto the stove and into the fry pan, sizzling and popping like pop corn. Taverner was unperturbed, flipping them out of the pan with the egg ladle and kept on with his cooking!"

Later in June they set up camp by Roaring River, where the air was cooler and drier, and free from insect pests. While Shortt and Watkins were exploring a poplar-willow habitat, and its wealth of butterflies, ,Taverner remained in camp. When Shortt returned this was what he found:

"Returned to camp at 12:30 and was treated to a Taverner surprise — roast woodchuck! He had shot the animal and prepared and cooked it during our absence. I was pleasantly surprised at how good it tasted, tender and rather like pork."[69]

Shortt closed his note to me saying that after Taverner had left for Ottawa — "We missed him, his humour and his cooking."[70]

*Family life of the Taverners, 1936-1942*

In chapter 15 a section was included on the Taverners' home life, based mostly on correspondence between Percy and his friends about their garden, and their enjoyment of music. Another section about their home life is included in the present chapter, drawn mainly from material from several of their younger relatives and friends, relating to the period 1936 until Percy's retirement in 1942. Other material for this section has been taken from correspondence between Percy and friends, or related to me in personal interviews, sometimes supported by tape recordings. Much of this comes under the title "oral history", and in quantity amounts to more than can be used here.[71]

This section begins with a paragraph by Taverner in a letter to Bishop about a week's holiday that Percy and Martha had spent in October 1936, and continues in the same letter with information on the development of their rock garden at 45 Leonard Avenue. Taverner wrote:

"The two of us spent a week up in Muskoka where I summered for so many years when I was a boy. I dont know any summering place that is more attractive than Muskoka but the great influx of enormous wealth in my old section has spoiled it ... Our old home there now replaced by a hundred thousand dollar establishment. The beautiful natural rock shorelines built over with masonry retaining walls to make beds for masses of petunias and marigolds and everything out of keeping with the atmosphere of the place ..."[72]

"At home have been making another rock garden, hunting up good stone and bringing it in our car load by load. Have just finished it ready for planting and am beginning to wonder where or how long it will take to get enough alpines to plant it."[73]

One of the Taverners' musical friends, Paul Larose, wrote about Percy's Christmas roses, that each year he would dig through the snow carefully, where he knew that he had planted some, and bring out the most beautiful flowers for Christmas. "Percy loved his garden as he loved all things pertaining to nature."[74]

From 1937 until 1943 Taverner was busy obtaining choice wild plants for his garden from friends in Ottawa, at the Experimental Farm, and at the museum, and by exchange from his friends and acquaintances during their travels in various places.[75] Writing to Bishop about plants Taverner said "we gardeners" when he mentioned five Lady Slipper species in his garden, all doing well.[76] One particular plant he wanted was *Lewisia*. He wrote to Brooks: "wish I had some of those Lewisia that soon will be speckling your hillsides ..."[77] When Brooks did not send any Taverner wrote to Munro about exchanging wild flowers, and managed to obtain some *Lewisia* from him while sending Munro hepatica, bloodroot and jack-in-the-pulpit.[78] Also during the summer of 1937 Taverner was busy taking a lot of photos of wild flowers.[79] By the late 1930s Taverner's rock garden was becoming quite well known among wild flower enthusiasts and people came from distant cities to see it.[80]

In a letter to Laing in May 1941 Taverner noted that the work Laing was doing at his home in Comox sounded too strenuous for him. In the past, Taverner said, he was able to do such hard work. Now, when he looked at the digging he did and the rock retaining walls he once erected he discovered that he had to hire a man to take down his double windows and put up the screens. "But I find laziness has its compensations and leisure is pleasanter than lame backs."[81] Taverner's health was "winding down", though he preferred not to admit it, and instead blamed it on laziness and leisure, which it certainly was not. Apparently, spring in 1941 was two weeks ahead of normal time and the flowers came through "better than ever". As regards the alpine plants, he wrote:

> "My rock-gardening friend who raises all sorts of alpines that no one else can grow in little pots has had to move to a location where he has no ground for even his condensed gardening and I have fallen heir to a great lot of stuff and my rockery is chock full of rarities that I hope I can hold. As an example to the difficulties of these slow growing and exacting alpine plants, I planted some seed of tulip species in 1933. They are just showing their first blossom. And some of these high mountain and arctic seeds don't germinate for two or three years."[82]

If Percy was the gardener, Martha was the musician. Because Martha started teaching the piano after arriving in Ottawa there were a number of people with vivid memories of being taught by Martha in the 1930s and early 1940s, who helped me during the 1980s and early 1990 when I was writing this book. Stuart Jenness started lessons about 1933, when he was eight years old, and continued until 1944, coming twice a week for an hour after school, and also to practice on Saturday afternoons. This usually coincided with Percy Taverner being at home. With practice completed to Martha's satisfaction, young Stuart might be allowed to go down to the basement to watch Percy in his workshop as he created various articles from copper. But piano practice had to be completed properly first. If he was cheeky Martha might "take a swipe at his head" — in fun — but she would not tolerate any slackness — Martha had been a professional piano teacher at a private school and knew how to keep discipline.[83]

Another piano student was Barbara Lowe (Reynolds) who became a good friend of Martha. Her future husband, Walter Reynolds, was suddenly called overseas at the end of 1939. She did not see him again until the end of the war. As a result Barbara spent much time at the Taverners' in the war years.[84]

There were a number of other piano students who became fond of Martha, and had fond memories of "Mrs. T.", as they called her. Some remembered the sessions on musical appreciation which she gave in the living room using her piano and the phonograph (record player). About ten students, mostly of high school age, would sit around the living room while Mrs. T. explained some music to them before playing it on the phonograph, which was placed in the sun room next door, with the glass doors fully opened.[85]

It was a great occasion when a visiting symphony orchestra played in Ottawa, and the Taverners and their musical friends had the chance to hear a live orchestra and discuss its performance afterwards. One such event was in December 1938 which Percy related to his old friend Mack Laing. Radio and phonograph, he wrote, are worthwhile but when you hear a live concert you know the difference, and he explained what it meant to them in Ottawa. "We are in the semi sticks and only have such an opportunity once in about two years. Ottawa is quite snooty about its superior culture, yet the majority of our friends have never heard a real orchestra before."[86] The other kind of live music that they could enjoy was when they made their own. As Martha became known in Ottawa musical circles she gathered together several musicians, and they would hold evenings of music and conversation followed by delicious plates of food. Sometimes there were visiting musicians invited as guest performers, but usually the music was performed by a trio or quartet of talented friends.[87] One of these was a good amateur cellist, Paul Larose, who spent many musical evenings at the Taverners'. About Percy Taverner he wrote:

> " ... although not a musician himself he enjoyed the numerous musical evenings which were held at his home. We had much chamber music with Mrs. Taverner,

and many were the visitors who profited from these musical evenings. It was on such occasions that I met people such as Dr. [Diamond] Jenness, Dr. [Erling] Porsild and other friends of the Taverners'." [88]

During Percy's and Martha's married life their house at 45 Leonard Avenue saw much entertaining. When they were first married they employed a Scottish housekeeper who wore formal white uniform, and did the bulk of the cooking, a housemaid to do the cleaning, a yard man to cut the grass and do the heavy work of the garden. Percy did the weeding of the rock garden and gave instructions about garden work. In his later years, when his heart was a little groggy, Martha would tell him when he had done enough weeding. The Taverners entertained once a week on an average, and had house guests quite often.

Karel Wiest lived at 45 Leonard Avenue during vacations from Cornell University starting in 1930, and had a German shepherd puppy named Sinbad. Later, when Karel was living away from home Sinbad, or "Sinners" as he was usually called, became a regular member of the family. Because Percy had designed his own home it was reasonably comfortable by the standards of that time. There were some details of design and decoration which were unconventional, as one might expect from Percy. The most original room was the living room with its large Steinway grand piano at one end, and the fireplace at the Leonard Avenue side, complete with an inglenook [chimney corner] and padded bench and bookshelf. On the ceiling were four wooden beams holding metal leaves made by Percy and designed to hold four light bulbs, which gave the ceiling a stylish appearance. Around the walls of the living room were several paintings of birds by Brooks, Fuertes, Lodge and others. A chandelier hung from the ceiling.

A room that Percy was especially pleased with was the sun room with a large desk for him to work at, a couch by the windows facing onto the garden, and a phonograph, though this could be brought into the living room when required. There were paintings round the walls, some probably by Frank Hennessey. Since Taverner worked in the sun room in the winter there was a system of forced air through ducts which had ornamental metal grills, another sign of Percy's workmanship. Glass doors separated the living room from the sun room. Upstairs there were four bedrooms, the visitor's room having a small wrought iron balcony.

The basement was well planned and built with superior workmanship, no surprise since Percy designed it for his own use, and watched over it being built from a rented house quite nearby. Karel kindly sketched for me a plan of the basement as it was in the 1930s which included a darkroom for Percy's photography, and a still room. Karel said that Percy liked a glass of Scotch, and bought it by the carboy. These he stored in the still room in the order of the year bought, so as always to have well-matured Scotch available. By nature Percy was convivial with friends, but Karel never saw him drunk, only merry in a good sense of the word. He was never a lone drinker, a habit which he disliked, but he enjoyed a drink when in pleasant company. At the AOU Stated meeting each year an evening was set aside when the men who wished to really drink, and tell stories, could get together without the company of wives. Percy had a ready wit and took an active part on these occasions. While living with his mother and stepfather Karel learned how to work in copper and pewter with Percy.[89] Various things they had made were to be seen in their home, and at their cottage at Blue Sea Lake.

One of the piano students, Barbara Reynolds, spent so much time with Martha that she became a longterm member of Martha's "extended family" of young people in the 1930s and early 1940s. About her life with the Taverners she wrote:

"There was always something going on in the house. The sun porch was often the centre of activity. I watched Percy bind old books, learned how to knit German style and listened to records. Sometimes Sinbad, the German shepherd, would groan to the music and had to be removed. The Taverners and 45 Leonard enriched my life and that of many others."[90]

By the late 1930s the street layout in the Taverners' section of Ottawa had grown considerably since building started in the 1910s. At the south end of Leonard Avenue runs the Rideau River through flat land, and liable to flooding extensively. At the north end of the avenue is Colonel By Drive and the Rideau Canal. Trees and shrubs lined both sides of the canal between Bank Street to the east and Bronson to the west where a swing bridge crossed the canal. On a summer's evening the north side of the canal, as seen from Leonard Avenue at Colonel By Drive, had mature trees in the gardens which stood back from the gently curving canal, adding depth and variety to the greenery. The open sky above the canal and gardens, on warm summer evenings, was especially peaceful. Here a procession of clouds, like mountains of white cumulus, might drift slowly by, and a male Redwinged Blackbird proclaim its territory with a loud *conqueree*, and a silent gull or two might glide effortlessly above the canal - these were evenings to quiet the mind and rejoice the heart after the petty vexations of the day's work.

In 1937 Taverner received a letter from a young nephew of his long-time ornithological correspondent, Frank Farley of Camrose, Alberta. His name was Farley Mowat. Through his uncle he wrote to Taverner about his bird watching activities in Toronto. The following year he wrote asking Taverner for advice on a project that he and another naturalist, Frank Banfield, hoped to carry out in the

summer of 1939 in Saskatchewan, making a collection of birds and mammals. Mowat asked Taverner two questions: where would be the best area to collect specimens, and could he recommend museums in Canada and the States where they could hope to sell them. Taverner agreed to help and a correspondence followed between the young student Mowat and his senior ornithological mentor until early 1940. The collecting expedition in Saskatchewan was a success, and both men had short accounts published.[91]

*Taverner's Last Publications*

In 1934 a new style of bird guide was published by an unknown man, twenty five years old. His name had a musical ring about it — Roger Tory Peterson — and the title a down to earth sound — *A Field Guide to the Birds*.[92] This book was reviewed in *The Canadian Field-Naturalist* by Taverner who went straight to the heart of the subject in his first paragraph.

> "A book that the amateur bird observer has long been looking for and which the most seasoned ornithologist will find of value. Presented as 'a bird-book on a new plan' it is the culmination of a movement in popular bird literature, that has been for some time in progress, whereby bird study has been stripped of its technicalities and with no loss of real accuracy, the meat offered to the general public without a shell of scientific verbiage and pedantry. It seems difficult to see how, within its class, it could be improved upon. It is a very practical working manual of field-marks, ignoring confusing detail and concentrating on the salient characters by which one bird can be distinguished from another under ordinary field conditions. It is not for the closet naturalist identifying birds in the hand who has other literature for the purpose; but, for the field worker who depends on eyes and glasses for the recognition of species, it will be invaluable. For this purpose it is far and away the best that we have seen."

Taverner wrote with an artist's appreciation, and an ornithologist's experience. He had, he wrote, tried to do something along similar lines, and could speak of the difficulties, as well as the success of the author's accomplishment. Taverner said he had examined the book with a rather critical eye, the result of considerable experience, but had found little to object to and much to admire. He then discussed Peterson's illustrations.

> "Nearly every species is illustrated either in black and white or in colour. A few of the former are pen and inks but most are wash-drawings in half-tone. They are not naturalistic representations, but are more or less conventionalized or diagrammatic, with confusing details omitted, to show the bird as it appears to the eye in the field with the critical distinctive points emphasised. The drawings are remarkable for their clear definiteness. The author-artist shows not only competent draughtsmanship and command of his art-media but knowledge and feeling for his subjects. In many cases in these simplified sketches he has caught the spirit as well as the outline and pattern of the various species. Many birds in juxtaposition are shown in identical attitude, a proceeding that may not satisfy artistic yearnings but is of practical assistance to direct comparison. Particularly should be mentioned the coloured plates of sparrows and warblers; these birds are shown of small size but with a sharpness of detail that is unusual in four-colour half-tone work. For these the plate maker and the printer should be commended."

He ended his review with a practical note on the format of the book.

> "It is a light, compact little volume in waterproof leatherette binding to stand the weather and fits nicely into the side coat pocket, just the form, size and substance to accompany one on a walk in a birdy neighbourhood. We highly recommend it and anticipate a great success for it. — P.A.T."[93]

Taverner's large book *Birds of Canada* was published in the same year as Peterson's *Field Guide* (first edition). The difference between them, both in purpose and approach could hardly be greater. But in 1939 Taverner, himself, published two pocket field guides. How this came about he explained in a letter to Brooks. "I am preparing a little field-guide book something between Reed's pocket guide and the Birds of Canada. Doing it for the Mussons. Think it will be quite a popular amateur aid and it is a rather interesting job. We are using the colored plates from the bird book and a lot of new line drawings."[94] In fact he wrote two books in order to make them *pocket* field guides. These were titled *Canadian Land Birds* and *Canadian Water Birds*: *Game Birds*: *Birds of Prey*.

In the Foreword Taverner explained that this small book was designed as a hand-book of Canadian land birds that would be of interest to amateur ornithologists. It was not intended to be a complete check-list of the birds of Canada. He explained that instead he had included a Field Color Key of land birds based on spring males of the more characteristic or commonest species. For instance four species begin with the words blue-gray, twenty-two begin with the color red, and continue from there so that "Red spot on crown, otherwise dull olive" is distinguished as Ruby-crowned Kinglet, and is described on page 148, with a coloured illustration of both Ruby-crowned and Golden-crowned Kinglets, and a sentence on their "field marks". The Introduction is useful, covering such subjects as bird photography of which he wrote:

> "It forms a great sport as exciting and demanding as hunting with a gun, and gives more permanent and satisfactory trophies as a result".

Another subject dealt with was bird houses for colonial nesting birds such as Purple Martins, with eleven illustrations of different designs of houses and feeders.[95]

In the same year that Taverner's two guides were being published, Peterson's *Field Guide* appeared in a revised and enlarged edition (1939). It received an appreciative review from Frank Chapman, which began:

"When, at the age of five years, a book graduates into a 'completely revised edition' one concludes that it was well born and has passed a distinguished youth. That its future will be marked by many new editions there can be no doubt, but the present one leaves small room for further revision."[96]

While Peterson's guide began at loons and concluded at Snow Buntings Taverner's *Canadian Land Birds* began at Band-tailed Pigeon, illustrated by a very life-like painting by Brooks (size 8 cm x 6.5 cm) from *Birds of Canada* (1934). The banded tail was shown in detail by a line drawing from Taverner. The next species were Mourning Dove and Passenger Pigeon with illustrations showing the two species side by side and drawn to scale of 1/4 of life size. The Yellow and Black-billed Cuckoo followed with black-and-white drawings of the two species in flight on the left page and a coloured illustration of the two on the right page drawn to 1/3 scale. Four hummingbirds were included: Ruby-throated, Rufous, Black-chinned, and Calliope Hummingbirds. The last two species were illustrated by black-and-white drawings only. Not all coloured illustrations were by Brooks; a number were by Hennessey from the colour plates in *Birds of Canada*. The difference in style of bird illustrations shows up clearly in a colour-wash of an Eastern Phoebe by Hennessey, which has a page to itself. The posture of the bird, as it sits upright on a small branch beside a wooden bridge, is very characteristic. Some notable illustrations by Brooks show: Steller's Jay; Clarke's Nutcracker; Varied Thrush; as well as 19 species of wood warblers in spring, and 18 species of sparrows, finches and buntings.

In his Foreword to *Canadian Water Birds* Taverner explained that Land Birds and Water Birds were intended as non-technical handbooks for identification of practically all the birds of Canada, and most of those in the northern part of the United States. Many of the illustrations in the *Water Birds* volume were from *Birds of Canada* but two new ones were painted by Brooks, two were by Cyril Johnson, one by Ronald Smith, and one was initialled P.T. In a short introduction to "Water Bird Study" Taverner discussed the decline in numbers of water birds, and the need for strong laws for the preservation of wildlife.[97]

Taverner's *Canadian Land Birds* was reviewed briefly by Frank Chapman in *Bird-Lore*. He wrote, in part:

"Of all the guides to our birds, I do not recall one that seems so well designed to fit the student's pocket and his needs as this one of Taverner's. With the exception of two Petersonish additions, apparently by the author, the coloured plates by Brooks and Hennessey are from Taverner's 'Birds of Canada'. As a rule they occupy the upper part of the right hand page. Beneath them are paragraphs on field-marks, habitat and nest, and on the facing page a freshly written biography which rivals in form and content the life histories of the earlier volume [*Birds of Canada*] ... There are introductory chapters on 'Method of Study', 'Birds of the Garden', a 'Field Colour Key', and the best of all an announcement that a companion volume on the water birds, game birds, and birds of prey will soon follow."[98]

Taverner replied thanking him for his review and saying

"You have always treated my books kindly and there is no one whose judgment in this particular field I regard more highly."

He continued:

"I note the Petersonesque color plates but no one seems ever to have remarked the Taverneresque hawk-plates in Peterson which, however, is nothing against that talented artist-writer whose Guide I greatly admire ..."[99]

Taverner's *Canadian Water Birds, Game Birds, Birds of Prey* was reviewed in *Bird-Lore* by Robert Murphy, who wrote:

"Mr. Taverner, who is to all effects the official ornithologist of the Dominion of Canada, here continues his series of true pocket handbooks. The present volume covers most of the birds with which sportsmen come into contact, and the author hopes that it will serve to inform them "upon the species that they seek to perpetuate."

By attacking his object through keys, brief and selective descriptions of plumage, and a wealth of illustration in both black-and-white and color, Mr. Taverner has produced the most practical of all books for its field ...

Mr. Taverner's brief biographical notes are excellent, with an intelligent and sympathy-awakening plea for conservation running throughout."[100]

In 1940 Snyder and Shortt nearly caused bad feelings between Taverner and themselves. This was a matter that, if it had come to a head, might have resulted in a permanent breach of friendship to the detriment of all three ornithologists had not Taverner backed down and kept his feelings to himself. The matter arose as follows.

In 1924 the Biological Board of Canada felt the need of an authoritative manual of the birds influencing marine life along Canada's shores, and Taverner was asked to prepare this. Subsequently the Board changed its mind and Taverner was told the manual was not required. He decided to enlarge its scope to cover other ornithological fields. This was completed and presented for publication in 1931. For reasons of economy it was not published at that time. Since then Taverner annotated it from time to time in an effort to keep it up to date. After Taverner had been made Chief, Division of Birds, at the museum he again made efforts to get it published, and another major revision of the manuscript was carried out. A copy of the ms. entitled "Practical Manual of Water Birds, Upland Game Birds and Birds of Prey of Canada" was sent to F. C. Lynch, chief, Bureau of Geology and Topography.[101] In his introduction to the manual Taverner described it as designed as a practical means of identifying the Water, Game and allied birds of North America.

"... It has been particularly aimed at the sportsman and general naturalist, it is hoped that it is not thereby disqualified from usefulness to the serious specialist."

The ms. followed the slow path of a document in government routine. Eventually a memorandum about the publication of a Museum Report on the "Practical Manual of Water Birds" etc., signed by John McLeish, Head, Mines and Geology Branch, called a meeting on 9 August 1938 at which Lynch, L. L. Bolton, Taverner and two others agreed that: "The Department proceed at once with the publication of the English edition of Water Birds, Upland Game Birds and Birds of Prey. In due course this recommendation was sent by McLeish to Camsell. Taverner appears to have had a presentiment of things going wrong again with the manual in a letter he wrote to Brooks written early in 1938. He said that he had been working against time to bring it up to date on a chance of publication, but feared that he had missed out "for this fiscal year at any rate." He hoped that he could get it published before his retirement time which was not far away. Then he made a revealing remark. "Perhaps I won't be so sorry when that time comes, I fear the deadening influence of the Civil Service is beginnning to get me."[102]

Nevertheless Taverner was surprised and hurt by the turn of events in 1940. Apparently without warning from Snyder or Shortt, Francis Kortright called on Taverner with a letter of introduction from Snyder which read as follows:

"Dear Mr. Taverner:

This is to introduce Mr. Kortright who is doing a nice job of producing a Duck-Goose Book. I have suggested that he should follow you in the *Branta* group and get your opinion on Todd's new Ungava form. Otherwise he is following the A.O.U. (1931). I'm sure he will appreciate *any* suggestions and I assure you we will appreciate it if you give him help. Regard.

Yours truly
L. L. Snyder"[103]

Worse was to come as this extract from a letter of April 1941 from Taverner to Snyder showed.

"Kortright was in the other day and he showed me the paintings and many pen and inks that Terry has made for him. Terry has done a mighty good job in these and is to be congratulated. It is going to be an outstanding piece of work but I can see how heavily he has leaned upon you and your museum. It however puts quite a fly in my ointment for it completely overlaps and renders useless the manuscript I have been working on for years but which, without all these colored plates, cannot begin to compete with it."[104]

Snyder replied that he regretted the overlap that the Kortright book caused with Taverner's ms. but explained it by writing:

"Money talks and he has done a good orderly job of compiling this book. Terry tells me there is some talk of cutting out his beautiful plates of eclipse and off-plumages which have made the book unique."[105]

At this time Taverner was working on a paper on the distribution and migration of the Hudsonian Curlew [Whimbrel], and asked Snyder for information on the specimens the ROMZ possessed. When thanking Snyder for the information he said in the same letter,

"Yes, it is something of a disappointment that my big opus should be so anticipated and overpowered by the Kortright book, but that cannot be helped. Mine was on the verge of publication several times in the past decade or so but always fell through at the last moment. Of course I cover more than ducks and geese but there is hardly enough left with them out."[106]

Taverner accepted the disappointment as best he could. He had a warm nature and was not the man to bear a grudge for long. Friendship to him was more than success, or getting his own way. He could not expect this compilation on ducks, backed by Ducks Unlimited, and supported by the ROMZ, with the superb colour portraits by Terry Shortt not to take the market. Taverner's mistake had been to enlarge the scope of his work from water birds to include game birds and birds of prey. By 1938 wild ducks were important in the eyes of sportsmen and naturalists, and a book about them could be expected to sell. Compared with Kortright's book which was forward looking in 1942 Taverner's ms. was rather outdated by then. This extensive study was completed, but unpublished when he died, and has remained so ever since.[107]

Three papers, for which Taverner had been collecting material for ten years or more were published just before he retired. The first, a short paper entitled "Variation in the American Goshawk", appeared in *The Condor*.[108] After examining variations in the plumages of two series of specimens he proceeded to demonstrate that fineness of pattern had no particular geographical distribution, and was a process of age, not a racial character.

However, a group of [Northern] Goshawks from the coastal islands of British Columbia stood out strongly from the others. They included both finely and coarsely marked birds, but all showed degrees of darkening. Taverner devoted the remainder of the paper to a discussion of the degrees of darkness in birds from Queen Charlotte Islands (5 specimens) and Vancouver Island (19), and the lack of darkening in birds from closely adjoining mainland localities. From comparing these specimens Taverner felt that there was a recognizable strain of goshawk on the two islands distinct from *Accipiter gentilis* of the continental area.[109]

Taverner then wrote " I therefore propose

***Astur atricapillus laingi*** new subspecies. Queen Charlotte Goshawk (Named in honor of Hamilton M. Laing, who has been instrumental in uncovering the form.)

Ottawa, Ontario, January 12, 1940."

Taverner's new subspecies was subsequently accepted by the AOU Committee on Classification and Nomenclature of North American Birds.

Taverner's second paper, published in *The Wilson Bulletin* near the end of his life, was on a very different subject. Its title was "The Distribution and Migration of the Hudsonian Curlew".[110] During his voyage in the Arctic in the S.S. *Beothic* in 1929 Taverner noted the huge numbers of Hudsonian Curlew [Whimbrel] that migrate along the north shore of the Gulf of the St. Lawrence and down the east coast of the U.S. In a letter to Fleming he raised the question of where, in the arctic, they bred.

> "They are practically unknown on Baffin Island but must work up into the central arctic islands. Soper did not find any in eastern Baffin Island. The great thing will be when arial [aerial] navigation is developed so that we can use it to reach this country. To get in and out in one season will open a great field for ornithological work up there."[111]

Information on the eastern migration was considerable. Taverner introduced it as follows:

> "The Atlantic migration is more complicated and follows different routes in spring and fall. The Hudsonian Curlew is powerful on the wing and quite capable of making long sustained flight. Its staple food in the north is the low-lying fruit of the subarctic barrens, particularly the crowberry (*Empetrum nigrum*) on which it gorges. Farther south the fiddler crab of the sand beaches seems to be its main food (Wayne, 1910). Its migrations are probably largely governed by the presence of these or similar foods. Where they are absent along travelled routes the birds are likely to pass over or pay only occasional visits in case of necessity."[112]

In a summary Taverner restated briefly the main points of his paper, and in his final sentence said:

> "We suggest that there may originally have been a Mississipi Valley group connecting the two breeding areas in the north but which were recently extirpated — perhaps along with the Eskimo Curlew, with which the species seems to have been closely associated in migration."

"Canadian Races of the Great Horned Owl" (hereafter G.H.O.) was the third of Taverner's late publications.[113] For most of his years at the National Museum Taverner was collecting specimens of the G.H.O. in order to work out the races found in Canada. His earliest attempt was a brief discussion of three races in his *Birds of Eastern Canada*. About designating subspecies, he warned that:

> "As these [races] intergrade with each other indistinguishably and overlap in range in migration, exact subspecies designations should be made only with great care and, except in extreme plumages, only after comparison with duly authenticated specimens."

Taverner's account of the G.H.O. in *Birds of Western Canada* is considerably longer than in his Eastern Canada book. Here he discussed the five races recognized in Canada in the AOU Check-list (1910), with a generalized description and distribution of the west Canada subspecies.

Finally he made one more attempt to bring his study of the races of the G.H.O. up to date before retiring. In a letter to Laing he wrote that there was little bird news, but Allen, editor of *The Auk*, had accepted his Horned Owl paper with "commendation". Taverner continued:

> "It does run counter to many philosophies and will probably not be generally accepted, — at first. However I do think that we should let up a bit on the microscope and use a telescope more to get the general view of our specific variations in a broader field. Many cannot see the woods for the trees."[114]

When finally it was published it contained his summation of about 25 years of intermittent work on the subject.

Taverner's *Birds of Canada* (1934) was becoming out of date by mid-century, but there was no book of equal scope to replace it until a completely new work with a slightly different title, ***The** Birds of Canada*, by W. Earl Godfrey was published by the National Museum of Canada in 1966.[115] Thus a period of 32 years passed between the publishing of Taverner's *Birds of Canada*, and Godfrey's *The Birds of Canada*. In those years the great changes which took place in ornithological studies can be measured by comparing Taverner's national-scale study of ornithology in Canada with Godfrey's on the same scale, but undertaken by ornithologists with different training, and working with very different equipment. The breeding distribution of the bird species shown on maps in the 1966 volume was an important innovation that Taverner would have been delighted to have used if he could have afforded it in 1934. John Crosby's coloured illustrations were deliberately painted and printed to give the ornithologist a high degree of definition in a reference book designed for use in library or laboratory. These bird illustrations show a clear difference from the style employed by Brooks. A comparison between the Taverner *Birds of Canada* and Godfrey's *The Birds of Canada* aptly demonstrates is that the study and practice of ornithology is an ongoing and co-operative pursuit.

## CHAPTER 17. In Retirement

Percy Taverner was due to retire on reaching sixty-five years of age in mid-1940. But by then the Second World War had started, and since no replacement had been found for him Taverner's appointment was extended for another year. This was a disappointment for Percy and Martha who had been looking forward to retirement from early 1938.[1] Finally, Dr. A. L. Rand accepted the position of assistant zoologist at the

National Museum of Canada in March 1942.[2] While Taverner was handing over to Rand he was also in the process of going into retirement, not a simple matter for someone who had held the same responsible position at the national capital for 31 years, and during the difficulties of wartime. If there had been no war then he could have attended the AOU meeting in 1940, with an opportunity to say good-bye to a fair number of his long time ornithological friends. But suddenly financial controls had become very stringent. Visitors on business to the States now had to supply an itemized expense account of necessities, and were limited to that amount. In a letter to L. Bishop of July 1940 Taverner said:

> "It seems strange also to me who has bounced back and forth across the line all my life and felt equally at home either side that I am [an] alien with passport necessary, photographs and finger prints. I wonder if the old freedom will ever return. Probably not in our time, these things have a way of sticking like pitch."[3]

The only way that Taverner could tell naturalists in Canada and the States that he was retiring in 1942 was to put a notice in *The Canadian Field-Naturalist*, which he did. It was published as follows:

> "It is with real regret that *The Canadian Field-Naturalist* publishes the following announcement of the retirement of Mr. P. A. Taverner as Ornithologist of the National Museum of Canada. Mr. Taverner has served long and well and this journal is deeply indebted to him for his services as Associate Editor (Ornithology) over a period of many years. — Editor.
>
> This will announce to those interested that, after thirty-two years, I have reached the legal limit of service and have retired from the position of Ornithologist in the National Museum of Canada. The Division of Ornithology will continue under the direction of Dr. A. L. Rand, whom I heartily recommend to correspondents, friends of the Museum and ornithologists in general. I hope they will extend to him the same support and assistance that has made my past labors pleasant. Future official communications should be addressed to him."[4]

In the last paragraph he said that he would not be dropping his interest in ornithology or in the museum, and would always be glad to hear from his ornithological and other friends. His name and address was printed at the end of his letter. At the same time he told some of his friends, by private letters, of his retirement. Here is Percy Taverner with a graphic account, in a letter to Mack Laing, of what it was like when he reached the end of his career. He said he was in "an awful mess" because he was due to retire shortly.

> "Pulling thirty years of roots out of all the stuff here [i.e. in the museum] is difficult … and there is a thorough "change of life" ahead."

Then there was the problem of space at home for his books.

> "Even our home here is uncertain. We would like a milder climate and smaller quarters for us two … yet what can we do or where can we go under the war restrictions. Have thought of the west coast. What are the possibilities of somewhere near you?"

Next he told Laing about Rand who had started work at the museum in March and what it felt like to see a "new broom" at work, and what Rand's views on ornithology appeared to be. One point was clear:

> "He is much more of a critical subspecies shark than I am but seems well balanced."[5]

What Taverner might have said, but didn't, was that Rand was ambitious, and determined to get his name into print quickly. Although he only started work in March he already had an article published in *The Canadian Field-Naturalist* of November-December 1942, and on a particularly Canadian subject — Kumlien's Gull.[6] In this paper Rand gave a short outline of the breeding distribution and relationships of eight Nearctic gulls of the Genus *Larus* in the National Museum collection. The section on *kumlieni* was based on Soper (1928) and Taverner (1933). The relationships of the group were represented diagrammatically, and a map showed their overlapping distributions. In the last sentence Rand wrote:

> "In preparing this paper I have had the privilege of discussing it at length with Mr. P. A. Taverner."

From Taverner's point of view he must have been only too glad to introduce Rand to the material on *Larus kumlieni* and its allies that he had been collecting for the museum since 1916, and the result of many discussions he had held with other ornithologists. Under Rand's name, at the beginning of this paper were the words: "Ornithologist, National Museum of Canada, Ottawa". while immediately beneath Rand's paper was the heading "Mr. P. A. Taverner Retires", a neat handover in print from the outgoing to the incoming ornithologist at the National Museum of Canada.

Answers to Taverner's valedictory letter on his retirement were coming in through the autumn. Twenty-four have been preserved, though Taverner may have received more. An official letter from W. B. Timm, director of the Mines and Geology branch, reached Taverner "placing on record the appreciation of the Mines and Geology Branch of your long and conscientious service of over thirty-one years." In the pompous prose of senior civil servants of that time he was patted on the back for his "laudable achievements". The situation at the Geological Survey to which Taverner was first appointed in 1911 was a lot less pompous when the lively R. W. Brock was director. In a different style was a warm personal letter from Harrison Lewis, chief Federal Migratory officer for Ontario and Quebec, saying how much he appreciated Taverner's help during his early years in the service. In another vein was something more formal from a well known member of the AOU, and assistant secretary at the Smithsonian Institution who knew Taverner quite well, but less

personally than did Harrison Lewis. This was Alexander Wetmore who wrote, in part:

"... You yourself have done a great piece of work in systematizing the collection of birds in your Museum, and also in adding to them tremendously through the field work that you have carried forward. I know full well the difficulties that you have had in this and also the pleasure the actual work has given you."[7]

After Taverner had handed over the direction of Ornithology to Rand, and received the usual six months' leave of absence before final retirement, he wrote a four page typewritten "Biographical Outline" of himself. This was a very modest and down to earth account of his development as a taxidermist, collector of skins, bird bander and as a student of ornithology at Point Pelee, which covered the first two pages. The other two were devoted to an outline of his work as Ornithologist at the National Museum.[8]

When W. E. Saunders died in 1943 Snyder asked Taverner for a contribution to the Saunders' memorial programme that the ROMZ was planning.[9] After it had been held Snyder wrote to Taverner telling him how well his contribution was received, and then turned to an account of Taverner's own career, and asked him:

"Has anyone ever urged you to write your autobiography. I'm doing it now. Perhaps the size of the volume which it deserved would be too much of a labour but let me have a few chapters — the cream so to speak."

Taverner replied in part:

"I do not feel that there has been enough of general interest in my life for an autobiography. I have prepared an outline for use when the inevitable time comes for an Auk memorial which I plan to deposit with your Museum. There are so few left who know anything about my previous life that some such guide seems necessary if the Auk continues the "obits" of Fellows."[10]

For a person in the process of retiring from a career that has taken up a major part of his adult life it is important to have interests, and perhaps a project which will keep his mind alive, and warm with a feeling of still being able to achieve something during his retirement.[11] Taverner's mind, at his time of retirement, and for a few years after, was still relatively sharp and forward looking, in spite of the loss of several contemporaries of whom he was fond, particularly Fleming. But Taverner had the ability to make new friends among ornithologists, and to share past experience and new interests with younger men of professional training. One such ornithologist was Ernst Mayr whom Taverner met at the AOU meeting in Washington in 1938, when they discussed new ideas concerning theories and practices in ornithology. Taverner learned from conversation that Mayr was especially interested in systematics and evolution, and in a few letters between them he was encouraged to examine the subject of bird species once again. In a letter to Snyder late in 1940 Taverner showed what he had been reading on the old problem of subspecies — J. Huxley on "the cline", E. Mayr's paper on speciation, and David Lack on speciation. Lately he had spent considerable time on the water thrushes, he wrote, but failed to make head or tail of them. "Perhaps I lack power of fine appreciation but anyway I fail as a splitter." What he had recently read suggested to him a paper that he wrote and called "Subspecific Values". This he sent to Snyder.[12] Also Mayr suggested that Taverner should read his book *Systematics and the Origin of Species.*[13]

In March 1943 Mayr wrote that he had learned with regret of Taverner's retirement from the position as Ornithologist of the Canadian National Museum.

"However, I hope that this means that you will have more time to devote to the study of birds and to other pursuits in which you are interested."

Then he told Taverner that lately he had become interested in the question of the degree of overlap between bird populations. In this connection he studied with profit Taverner's papers on the Long-tailed [Black-capped] Chickadee and the giant Red-winged Blackbird.[14] But Taverner did not give his complete measurements in these papers and Mayr wondered whether he recorded them. This was unfortunate, he wrote, since Taverner's data "represents a particularly nice case and I would like to use them if they are available." In the last paragraph he asked Taverner "Did you read my book and what do you think of it?"[15]

In reply Taverner explained how the graphs in both papers were made, and that the museum had the original tables from which the graphs were made, and that they would be available to him if he required them. Next Taverner discussed Mayr's book which he had just finished reading. He praised its clarity of presentation in places where unusual technical words were used.[16]

During the late 1930s we saw that Taverner was discussing changes in research into ornithology, and methods of teaching it. As a result he had begun to accept this as a necessary change in methodology even if he did not feel comfortable with it. When, in 1941, he received a letter from a farm boy in his mid-teens in Alberta, who had been forced to break off schooling due to lack of funds, asking for Taverner's advice on his chances of making a future in bird work in Canada, Taverner knew how to reply.[17] He began by saying that he received many letters of the same nature, some from young fellows who seemed to think the career of a naturalist an easy way of making a living, but few seemed to realize that "nowadays" more preparation than a desire was necessary for success. He went straight to the point, saying:

"The time of the self-taught naturalist achieving great success is past ... Today much more is demanded than an uneducated love of nature and an urge to wile away one's days in the woods."

It was necessary, Taverner explained, to have a sound knowledge of what had been accomplished in bird study, and what awaited to be done, as well as a familiarity with modern concepts and proceedings. This was difficult enough but when complicated by the necessity of making a living at the same time it was almost "prohibitive". He continued:

> "Nowadays the only practical door to a successful living through natural science is through academic education. The country today is full of well qualified college graduates in line for just such positions as you probably would like, and these have such a legitimate edge upon others that one might say none other need apply."

Taverner told Beddoes that he was not saying this to discourage him but to state the conditions and to point the way forward, and that many had struggled up from the most unpromising conditions

> "but only through hard work, intense application to an end and through University courses".

He then pointed to one way forward:

> "… There is always a lack of qualified nature teachers in the schools which gives one line of progress that depending upon the individual may lead to many things. As has been said many times there is always room at the top but the competition is keen and only the most determined and best qualified ever reach it."

Taverner tried to soften the harshness of his letter at the end by saying that

> "many have wangled [struggled?] their way through higher education against the greatest of obstacles. Others with all the ambition … have been by force of circumstances unable to do so, but usually where there is a will there is a way. Sometimes there is a conflict between duty to self and to family that stands in the way. These are hard cases and the outcome is up to the individual."

In his last sentence Taverner wrote:

> "I wish I could offer you more material assistance and advice."[18]

Meanwhile the war in Europe exploded into violence in the spring and early summer of 1940, putting an end to any hope that Percy and Martha had for an enjoyable retirement. However, quite unexpectedly Taverner received a letter from a woman living in a log-house on a cliff overlooking the Mattawa river in central Ontario near North Bay. She signed her name Louise de Kiriline Lawrence. Her reason for writing, she explained, was that she had been given a copy of his *Birds of Canada*. With the help of his book she had begun to keep records of each species she could identify positively. Her love of nature, she said, had begun as a child in Sweden. Now, in this isolated spot in the woods, with feeding trays and suet hung from branches around the log-house, she was deriving immense pleasure in observing the behaviour of the various birds around her. "May I tell of a few things I have seen?" she asked. Then she described with skill and warm feeling some of her observations in the spring of 1940. A pair of Purple Finches mating, six pairs of Rose-breasted Grosbeaks nesting in the vicinity, a Veery sitting on four eggs, a pair of Pileated Woodpeckers. Here, in the first of twenty-one letters that followed, were the kind of vivid observations that later made her books such as *The Lovely and the Wild* so enjoyable.[19] But in these letters she was writing about birds in anthropomorphic terms using such phrases as the male Purple Finch's "impassioned wooing of his demure little bride" and a male Rose-breasted Grosbeak singing continually near the house until she wondered "if he was neglecting his duties or whether he was a bachelor". At the end of this first letter she apologized for taking up Taverner's time for so long, but excused herself by saying that the only drawback of living far away from other people was that "one needs occasionally to find someone who knows more than oneself with whom one might be permitted to share impressions, crystalize observations and find guidance. Hence this letter which I trust you will not look upon as a presumption of me to have written. Meanwhile your book, excellent in a practical way and delightful in a literary sense, remains to me a prized guide and friend. If ever you should pass by this log-cabin would you stop and pay us a visit?"[20]

This letter reached Taverner at a low ebb in his career when he was wondering if the work he had done was of much value. In his reply to Louise Lawrence he expressed his thoughts frankly, and modestly.

> "Of course it is a great satisfaction to feel that any work one does is so thoroughly appreciated. In these days of great trial it seems that the study of little birds is futile and pickiune [picayune], but when I get such letters it makes one feel that life has not been entirely wasted, at least it has brought pleasure to some and perhaps to many more than have been moved to express it.
>
> "How much heredity and how much environment and early associations have to do with our developed personalities is an open and controversial question. But when they both combine to turn us towards keener appreciations of nature or of art it matters little which have had the predominant influence."

He promised that if he passed their house he would be happy to drop in, and invited her, if in Ottawa, "to look in on me".[21]

Their correspondence had begun well. Both had stated their need, Louise Lawrence openly, Taverner less explicitly though obviously enough. In her next letter Louise Lawrence took the opportunity of an episode concerning a duck that died of a gunshot wound, while she was caring for it, to write to Taverner again. From this letter Taverner learned that Louise Lawrence had a husband who had recently joined the forces, that she had a .303 rifle which she fired from her bedroom window to warn migrating ducks, in the bay below her, of danger from "sportsmen" firing from their car on the bridge on the highway. When the duck died she realized that she could at least make sure of its identity. She judged it to be a female Ring-necked Duck, and learning from Taverner's *Birds of Canada* that more

information about their range was needed, thought that her story about the "wingshot one" might interest him.[22] In the same letter she related how six Wilson's Thrushes [Veery], each in its own tree-top near the cabin "jingled their golden chains". to borrow a phrase from his book, in a matchless serenade.[23] She ended her letter by explaining her strong need to communicate her impressions to a fellow being with the same feelings about birds. "I would not wish you to feel under any obligation to acknowledge this unless you be so inclined, but please, permit me the privilege to write to you from time to time about my fascinating neighbours".[24] Who could refuse such a gentle request? Taverner himself had written about birds with a warmth of observation and a touch of sentiment just as Louise Lawrence was writing to him now. On the verge of retirement he had found another bird observer, in an isolated spot, whom he could encourage to report individual species with some degree of scientific accuracy; yet another link in his ornithological network. On her part Louise Lawrence would have the satisfaction of knowing that her bird notes were going to be read at the National Museum by someone who appreciated her efforts, and sent her encouragement.

During the next few years Louise Lawrence wrote letters filled with the excitement of her discoveries, such as the arrival of a male Cardinal at her log-house in the winter of 1941, and the appearance of a Black-billed Cuckoo in the summer of that year.[25] Taverner answered that the identification of the Cuckoo sounded correct, and that "one gets quite a 'kick' out of meeting and identifying a new bird, especially when it is an unexpected addition to the local fauna". It was not quite a new species, he said, as it was reported in a Lake Nipissing local list of 1939, but her observation did mark the farthest north extension of range in that quarter.[26] Taverner then wrote in general terms about their shared enjoyment.

> "This is one of the great things in bird study, there is always something new to look forward to with thrills spaced evenly enough to sharpen the interest. If this gentle art is a relief from the sterner atmosphere that surrounds us it is a blessing indeed. We need such relief these days. If I have had any hand in extending it I can feel that I have been of some use in the world."[27]

By late February 1942 the cardinal had started to sing and another letter from Louise Lawrence reached Taverner describing the incident. "It was strange". she wrote, "standing in the path with waist-high snowbanks just outside my house sitting deep in drifts up to the eaves and listen to the first spring notes of a crimson bird! Is there no climax to the marvels of our northern bush?"[28] By 1942 Taverner had introduced Louise Lawrence to bird banding, and she had told him of her harrowing experience when her officer husband was taken away to be shot during the Russian revolution. Taverner read two stories of hers and liked them. He wrote: "They are literature as well as good natural history and hence hardly material for 'popular' magazines. I should think they are Atlantic Monthly stuff. I advise you to try that." He enclosed the editor's address.[29]

The correspondence of Taverner and Louise Lawrence contains a moving sequence of letters which deserve to be read, not only for their revelation of the development of Louise Lawrence as a serious student of birds, and a gifted writer about them, but also for the part played by Taverner in that development. In a letter written only a few months before Taverner's death she said:

> "... the contact with you I count as the most important factor to my introduction into the bird world. It has been a great privilege to have known you, although I have never seen you. You led me on, step for step, and I recall with gratitude the help it was to be able to check with you my first little discoveries, the fox sparrow, the cardinal, the cuckoo, now all my long-established friends."[30]

This was the end of a long and rugged trail for Taverner, and the beginning of a fresh and exciting trail for Louise Lawrence, both distinguished Canadian naturalists.

Besides having their lives enriched by music, alpine wildflowers, interesting examples of domestic architecture and furnishings, Percy and Martha had the last few years of his life enlivened with the liveliness of young children. As Percy told a friend, they had recently been up to their cottage to prepare it for Karel who was bringing his family from Lansing, Michigan, the following week. He explained that Karel "has two little girls now as well as two older boys that he acquired with his wife. I expect the girls will be parked with us as our cottage is hardly a suitable place for such small children. I see that Martha will have her hands full but she loves it."[31]

In 1941 a step-son of Karel, Corwin Ferguson, was staying at 45 Leonard Avenue for more than a year while attending school in Ottawa. Writing to a friend on service in England this is how Percy described it:

> "We have a small boy with us, — not an English lad as it happens [evacuees from Britain had recently arrived in Canada] but a near relative. He contains more concealed and active energy than a phonograph spring and keeps things pretty lively about the house and place. What a lad of eleven won't think of to do is certainly unpredictable. So you see we are not exactly vegetating."[32]

Corwin was eleven years old then and he still has some clear memories of that period. He felt that Martha and Percy seemed very close, that she kept a watchful eye on his health, that by 1941 he was not allowed to climb up stairs as often as he would have liked — it was rationed. Martha also told him when he had done enough gardening for one day. But life at 45 Leonard Avenue was not austere in 1941 and 1942 — they still entertained often, and Corwin remembered house guests staying at their house even

in the early war years. Also people came from afar to see the rock garden at 45 Leonard Avenue while it was still in its heyday. Above all he remembered nephews and nieces, and "honorary ones" from among Martha's piano students being invited to stay at Hyla. Here were members of the family and an extended family, as well as close friends, such as Barbara Lowe (Reynolds) and Karin Porsild (Lumsden), all of whom referred to Martha as "Mrs. T" or simply as "T". She was the centre of the family, and many people corresponded with her regularly. Corwin's memories of Percy were about his stammer which was always with him, though at times he produced spontaneous witticisms, and amusing puns; he was not "put down" by it.[33]

Another member of the "extended family" was Marte, Karel's daughter and Corwin's half-sister, who stayed with Martha and Percy for about a year and a half,while her parents, Karel and Peggy, were abroad. Marte remembered Martha as a determined woman, not to be opposed. But Percy could stop her doing something if he wished, just by quiet moral authority. Marte told how T was spanking her one evening, and she was squealing, when Percy came into the room and, in a quiet tone of voice said "that's enough". and it was. Martha stopped at once.[34]

In the normal course of events Taverner would have retired in mid-1940. Already by the beginning of that year he was feeling discouraged. In a letter to Fleming he mentioned the death of Harlan Smith, commenting that "he was crushed by an unsympathetic museum and Civil Service regime and had all the heart taken out of him." Of his own situation he said:

> "It takes a more rugged man than poor Smith to keep fighting under these discouragements and I am at last beginning to understand his reactions to it. Certainly I have not the enthusiasms I had when I first came, and the fight seems less worth while."[35]

One quality that showed throughout Taverner's adult life was what might be termed "stubbornness". in the sense of extreme perseverence. A clear example of this quality can be seen in his never-ending attempts to get his "Practical Manual" published. This work had started in 1924 when the Biological Board of Canada wished to publish a fauna of the Atlantic coast as a students' manual, and Taverner was asked to write the bird section and include line drawings.[36] When the Biological Board cancelled work on the manual Taverner continued with his *Birds of Western Canada* until that was published. After that he was free to enlarge the scope of his "Water Bird Manual" which would not include game birds and hawks. By now the book was aimed at hunters, and would include a large number of text drawings and line cuts.[37]

If Taverner had completed the manuscript by early 1930 it might have been published by the National Museum, but a new Check-list of North American Birds was being prepared by the AOU for publication in 1931, and it was important that his book should cover a complete section of the new List. Unfortunately for Taverner, by the time it was sent to the publishers to examine in October 1931 it was too late financially, when the National Museum had to postpone many of its expenses.[38] Taverner did not give up hope and when he became chief, division of birds, at the National Museum he made another effort to get the manual published. In December 1936 Taverner's brother-in-law, John McLeish, became head of the Mines and Geology Branch of government.[39] Early in 1938 Taverner presented the updated manuscript of his "Practical Manual of Water Birds, Upland Game Birds and Birds of Prey" to F. C. Lynch for publication.[40] After various delays throughout the summer John McLeish, from his position as head of Mines and Geology, sent Charles Camsell, Deputy Minister of Mines and Resources a memorandum asking for approval of the publication of the "Practical Manual".[41]

However, early in 1939, with the threat of war hanging over Europe, the decision to publish was delayed. At this point Taverner, if he had been less "dogged" might have given up the struggle, but he didn't. Instead he went on persistently tinkering with his manuscript until in 1943 it was overtaken by a very different kind of book.[42] Eventually, as his health deteriorated, he seems to have realized that his "big opus". as he called it in his letters, would never be published. Writing to his old friend, Frank Farley, in 1944, he said that he was working on a book that had long been under way but whether it would ever find a publisher was another matter. "It may be love's labor lost but what the heck, it makes an objective now."[43]

So Taverner hung on doggedly until the end, and his last mention of his "big opus" was in his last letter to Laing two months before he died.[44] The failure to see his "Practical Manual" published before his death after so much work was a great disappointment, but perhaps Percy still hoped that it would be published on his behalf posthumously. But it was not to be, and the manuscript remains unpublished.[45]

In addition to his disappointment over the book, Taverner received very little recognition during his retirement. However, there were a few honours given to him near the end of his life. In 1945 he was elected an honorary member of the Ottawa Field-Naturalists' Club

> "in recognition of his outstanding ornithological work, and service in the interest of the Club. ... Probably he is best known to the members of the Club as author of 'Birds of Canada', and as long-time ornithological editor of this publication."[46]

In 1946 a new race of the Purple Finch was described by A. L. Rand in honour of Taverner as follows:

"*Carpodacus purpureus* ***taverneri***, new sub-species. Type No. 25387, National Museum of Canada; male adult; Government Hay Camp (Park Headquarters), Wood Buffalo Park, Alberta; May 26, 1933; collector, J. Dewey Soper."[47]

By far the brightest honour paid Percy Taverner was a posthumous one. On the front page of W. Earl Godfrey's revised edition of his *The Birds of Canada* (1986) is this inscription:

"To P. A. Taverner and Robie W. Tufts with appreciation"

Everyone who uses this edition should be glad to glance at the name P. A. Taverner on page 5. It is a living tribute to all that Taverner achieved during his 31 years as ornithologist at the National Museum of Canada. Also it is a mark of appreciation that will continue to live as long as Earl Godfrey's book is reprinted. Taverner could not have wished for a more enduring honour.

In contrast to the last years of Taverner's life Jack Miner received ample recognition right to the end of his life and beyond. Although Taverner was long-suffering by nature and did not express his inner feelings publicly, there is a hint of being hurt when, in a letter to Snyder, he said: "I see they are making quite a splash over Jack Minor [sic] again. It is quite a joke isnt it, — 'Canada's famous naturalist'. One would think him the only man who ever banded a bird".[48] In contrast Manly Miner, writing to Taverner about a visit by Saunders and him to the Miner farm in 1909 or 1910, said:

"Father had a great life since those dates. All the honors came to him that any one could enjoy. Yet we all helped him. I acted as secretary, made all the appointments. News releases and so forth. It all didn't happen in a day."

Manly wrote much more, including the fact that Mr. Mackenzie King was due to spend a weekend at their establishment soon.[49]

One other posthumous tribute was paid to Taverner by another Canadian ornithologist, Henri Ouellet, in an illustrated memoir published in *American Birds*, while the 19th International Ornithological Congress, held in Ottawa in June 1986, was still sharp in people's minds. The title was "Profile of a pioneer: P. A. TAVERNER" and immediately under it was the comment "Canada's first professional ornithologist still has a tremendous influence on the study of birds in Canada today".[50]

Anyone who has collected a library during their working life is faced with disposing of most of it before or during their retirement, both for lack of space and lack of use. Writing to Baillie in 1945, Taverner asked to borrow from the ROM collection an adult White-winged Black Tern [White-winged Tern], and a skull of one of the large waders to show in contrast with that of a Wilson's [Common] Snipe. He was still drawing illustrations for his "Practical Manual". In the same letter he said that he had arranged for the disposal of his library — to the Quebec Provincial Museum.

"I think I have made a fair deal. At least it will be kept together as a Canadian unit and be where it should be badly needed."[51]

The other library that Taverner wanted to dispose of consisted of "old standards", from classics to moderns in various editions, about 200 volumes in all. For this purpose he wrote to Angus Mowat, Inspector of Public Libraries, Department of Education, Ontario, asking if some country school or similar repository would appreciate them. He added that he would gladly donate them.[52] Angus Mowat's reply began:

"I have heard so much about you, and for so long, from my bird-crazy son that it came as a surprise and, I may say, a great pleasure too, to have a letter from you this morning."

Mowat then suggested dividing them into suitable lots for distribution among some of the small and struggling libraries in the north country. Any titles which they found unsuitable for that purpose "would be turned over to Frontier College whose people are always glad to receive books of any kind." In the final paragraph we see father talking about son with a touch of pride in his pen.

"Farley [Mowat] is busy with his university course and somewhat to my surprise is working like a nailer at it. Apparently his trip to Saskatchewan last summer was profitable, although not from the financial point of view, and he still hopes to make some arrangement with the people out there which will enable him to make that province his own field. In fact he already talks about it with a most proprietary air."

Angus Mowat ended his letter:

"Thank you very much for your letter and please accept my personal regards."[53]

Throughout Taverner's years of work at the National Museum he was often frustrated by some problem or other that should have been put right but was not, or should never have gone wrong in the first place. To discuss this problem satisfactorily would require considerably more space than can be devoted to it here. It should be written as a separate paper, and printed as a comment on the National Museum, rather than as an integral part of Taverner's life. It was only one year before he died that Taverner sent W. B. Timm, chief of the Mines and Geology Branch, a memorandum on the Status of the National Museum of Canada.[54]

In the summer of 1946 Taverner had written to an old friend, Dr. George Prey, and asked his advice on the possibility of spending the next winter in Florida, and the problems it would entail. The answer he received was not encouraging. In the fall he applied for accommodation but without success. As Taverner wrote "... everywhere we applied we found crowded."

The winter dragged on, only broken by short visits from old friends. One good omen was that in February 1947 an addition to the staff of the Biological Division of the museum reported for duty — W. Earl Godfrey. But by then Taverner was too ill to exert himself much in conversation and Godfrey only managed to meet him briefly once.[55]

Although Taverner was unable to talk at length on serious subjects he could still tap out letters on his old typewriter. Both A. E. Porsild, who was living with the Taverners, and an old friend of theirs, Mrs. Jean York, had told him that an enthusiastic bird-watching schoolboy might write to him for advice.[56] As a result there followed a friendly correspondence between the senior ornithologist at the National Museum in Ottawa and Henrik Deichmann, a schoolboy living near Saint John, New Brunswick. Deichmann wrote at the end of January 1947 telling Taverner that he had owned a copy of his *Birds of Canada* since the previous year which had made a great difference to his bird study. He was now reading it through for the third time, he said. He described where his family lived — in a little valley with a river running to the north, a high bluff in the east covered with trees, many stunted and twisted over the rocks. Looking westward were farms and woods. To the south lay the city of Saint John where on foggy days they heard the fog horn faintly. The letter ended as follows:

> "I am the boy Mrs. York was telling you about. I am twelve years old and a terrible speller so I keep running to my mother and ask "How do you spell this or that?" My mother says she wishes I could look things up in dictionary as eagerly as I do in the 'Birds of Canada'."

He enclosed a few of his bird sketches because he was so glad that Taverner had written *Birds of Canada*. He signed himself

"Your friend
Henrik Deichmann"[57]

Taverner replied that he was glad to receive Henrik's very interesting letter. That he had heard of him from Mr. A. E. Porsild "who knows some of your family". He continued:

> "It is very flattering and a great satisfaction to learn that my work and books have been so usefully employed and have given pleasureable information to others. It is to you youthful inquirers upon whom we have to depend to carry the work forward as we retire from the field."

In the next paragraph he wrote:

> In your letter I see a very great promise. You write well and I should say have considerable powers of observation. I hope you will cultivate them both. Your pictures also show promise and whether they are drawn from original subjects or are copies indicate that you are learning to control your pencil which is the basis of draughtsmanship. Keep it up and develop all sides of your possibilities."

But when he wrote about the many pathways through modern ornithology this may have seemed somewhat daunting to a twelve year old, though Taverner's conclusion was clear enough when he wrote: "But the basis of all is field observation and wide reading on biological and allied subjects." Taverner also said that he would be very glad to see his bird count records, or any other results or questions that he cared to send him. "If I can be of any further help, call on me." [58]

In thanking Henrik for this letter Taverner wrote:

> "I received your last letter with the account of your meeting with the Pileated Woodpecker, the sketch and the year's list of birds. They are all very interesting and if you continue to develop along these lines there should be a considerable future for you in wild life or natural history subjects. What you have accomplished apparently without special help is most encouraging but that is all the more reason for supplying all the guidance possible and even demanding more of you than from others less gifted. Therefore you must take it as meant if I seem to be severely critical. I will first take up your list.
>
> It is a common and almost universal error for the unexperienced amateur to see strange, unusual and rare birds. The mere fact that the amateur is restrained from collecting his suspects* supplies no correction to vizional [word coined by Taverner] mistakes to teach caution in identification or restrain[s] misplaced enthusiasm. That you have fallen into this error is quite understandable but must be guarded against. The greatest qualification of a naturalist is his reputation for caution and reliability, that he does not jump at conclusions without unmistakable evidence and understates rather than overstates his observations.
>
> In the first place I would say that while occasional birds may turn up in almost any unexpected place, they are extremely rare, and their occurrence can be admitted only on the most perfect evidence which usually means the production of specimens. Anyone who sees or reports any number of freak occurrences is ipso facto suspect."

Taverner continued by mentioning a list of birds near Henrik's vicinity in George Boardman, "Catalogue of Birds found in the vicinity of Calais, Maine, and about the Islands at the mouth of the Bay of Fundy".[59] It was also reprinted with annotations privately under the title of "The Naturalist of Saint Croix". Taverner advised Henrik to look for this in the Saint John library, and to study it carefully to see what was likely to be seen and what was improbable in his locality.

Taverner then went into detail concerning species that Henrik had claimed to have seen:

> "Gyrfalcon. The seeing of a single gyrfalcon in your neighbourhood would be sensation enough granting that identification were well established. It would not be greatly improbable to see a single and not much out of the way should you see one 11 times.' …
>
> Ring-necked Pheasant. I suppose your 123 birds represent individuals repeatedly recorded. I am surprised at

*birds that an amateur suspects to be of a certain species but is not certain.

Taverner in retirement with his favourite dog Sinbad, taken in 1944 or 1945, surrounded with many framed pictures of birds. This is the house which he designed in 1912 and where he died in 1947. (National Archives of Canada, Accession number 1984-1978 Hayes Lloyd collection.)

the Hungarian [gray] Partridge and would like to know how successful its introduction seems to be."

Ten other species were mentioned briefly. It was surprising to see the [Northern] Cardinal in this location, he wrote, though "it has certainly been extending its northwest range elsewhere." The Common and Red-breasted Mergansers, Taverner said, were difficult to separate in life, except for adult males. "Our records of them based upon eye identifications of females are in the utmost confusion."[60] "Don't be disheartened at this list of criticism". he wrote, "It is only to be expected in a beginner and it will give you an objective this summer in finding out what you really did see." By the way of praise Taverner wrote about Henrik's experience with the woodpeckers: "It shows a good use of language and a feeling for words. It is too good a start not to be cultivated. Keep it up. I wonder who is your teacher." In closing he urged Henrik to get in touch with Mr. Squires of the Saint John Museum, [though by a slip of the mind Taverner typed Mr. Spiers instead of Squires], and added — "I am sure he would be glad to see and help you, and personal contacts in chosen fields are always inspiring." This was Taverner's last letter in their correspondence.[61]

Henrik was very excited and happy to receive Taverner's letter:

"It is the best letter I have ever had. I am going to be stricter with myself and work harder, as I want to be a good naturalist. I have read your letter many times over. I think I almost know it by heart."

He then explained a little more about his home life.

"As we live away from town-amusements my two sisters and I spend a lot of our time writing stories and illustrating them. ... In about three weeks the river will open up so that the ferry can run again."

Then he planned to go to town on his bicycle and spend Saturdays at the museum.

"I think Mr. Squires will let me look at the books and specimens in there."

He ended his letter with a perceptive statement.

"Your letter has made me think of many things. Thank you again for it."[62]

Deichmann's last letter to Taverner, enclosing his spring arrival list, was dated May 2nd 1947. With this letter the correspondence between Percy Taverner and Henrik Deichmann ended.[63]

Will Saunders had died in June 1943. Now, in January 1946, another of Taverner's long time ornithological partners, Allan Brooks, died. Taverner wrote to his widow, Marjorie, with sympathy from Martha and himself. Marjorie replied with a warm letter in which she wrote, among other things:

"You and he were such close friends and your names being together in that Canada wide almost family Bible — The Birds of Canada, is a wonderful memorial & we are so proud it is so."[64]

Early in March Percy composed a two-page letter to one of his closest friends, Mack Laing. It was a good natured letter from one naturalist to another, both of whom had shared many interests for over a quarter of a century. "I wish I had your free flowing pen also a little more gumption with correspondence" was how he started his letter. He explained that in his present existence things flowed on so uneventfully that he had little to say. The weather seemed to be the one unfailing topic. It had been a comparatively mild winter up until recently, he said, and then three feet of snow dropped on them in a two-day storm. Everything was bogged down and even after a week of clearing they were only partially dug out. The entrance to their front door he described as "a snowy canyon". while the piles of snow were so high that they could not see a car entering or leaving on their garage driveway.

Percy then gave Mack a few snippets of news that they could share. The first was about Erling Porsild of whom he wrote:

"This winter we took in Porsild the botanist who could find no other accomodation in this crowded city and has been a very pleasant house mate. He takes care of a lot of the little household jobs that I am unable to attend to."[65]

The next was about someone who had known Percy's mother and Percy's early years. This is what he said:

"I have had a long letter from Mrs. Sharman of Oak Lake. Of course I never met her personally but she seems to be the only one I know of who knows anything of my early days and forbears. She must be a remarkable personage, at her age to retain such interests and clear faculties. Her writings and letters are those of a young woman. Strange too how different lifelines cross. Not only did she know my mother as a young woman but also is closely connected with other people who fortuitously had a great influence on my life."[66]

Later Percy wrote a little about the Museum, when he said that it was "stumbling along in its same uncertain way." They had some hope that the new Deputy Minister, Hugh Keenlyside might introduce a more enlightened policy.

"As it is, we are threatened with loosing Rand to Chicago or the British Museum. Rand after five years here and highly competent has only a minor classification and is yet labeled 'temporary'."[67]

Finally Taverner, the author who never gave up, made a last report on his Practical Manual when he wrote:

"There are some prospects of my big opus my Practical Manual of the Water Birds etc. seeing print. The Museum may handle it, if not the Arctic Institute is also interested. But things are still hazy."[68]

Prosaically Percy mentioned in the final paragraph that Munro and Cowan [Ian MacTaggart ] were in Ottawa the previous week attending the Provincial game conference.[69]

Percy signed the letter, as usual to friends, P.A.T. Under his initials Mack Laing later wrote the one word

*Finis* [70]

By early May spring had come, early flowers were opening, trees were putting on their first tender leaves, and early warblers were arriving. As Percy lay in bed his mind began to wander. When Martha came into the room he motioned her to come over to him. He hummed part of a melody which was in his mind but which he was unable to finish. Martha hummed the full melody to him. Soon afterwards, with the melody in his mind, his eyes closed and Percy Taverner died.[71]

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## Appendix 1:

✱ LAT-65° 35′ 1929. ✱
CAMP KUNGOVIK
WEST COAST BAFFIN ISLAND
✱ J DEWEY SOPER ✱

DEPARTMENT OF THE INTERIOR
CANADA

NORTH WEST TERRITORIES AND YUKON

OTTAWA JUL 18 1929

Dear Percy:

I am sure you will be glad of a note from this strange and remote quarter of Canadian Territory — a novelty at least — and bearing the stamp of a camp which I believe will not be entirely overlooked, presently, in the annals of N.A. ornithology. For I may as well frankly admit that the expedition has achieved unqualified success. It may be something to strike deep into an unknown Arctic wilderness, face what must be faced, and find that which is sought in a territory of thousands of square miles. Yet I am glad to say we have achieved this, and I am sure many others will feel the same way.

I left Cape Dorset on May 17 with 5 Eskimos, sledges and 42 dogs, loaded with necessary grub, fuel, equipment and a large freighter canoe, and after 8 days hard travel along Hudson Strait, up Charbak Inlet and across Foxe Land we established this camp on the 24th of May. I retained two Eskimos for the summer — Kavivow and Ashoona — and sent the rest with all the dogs back to Dorset in late May.

Here we have been ever since, perched in two heavy tents on a low granite outcrop in the great western tundra. This is the most abominable place for climate I have ever known, where I have suffered more handicaps and actual hardship than anywhere else in my Arctic experiences. The south coast, Pangnirtung, and Nettilling are tourist rendezvous in comparison. Winter continued in practical effect until well into June and even as yet, we have had only three comfortably warm days with a little real heat from the sun. Cold, everlasting cold, rain, sleet, gloom and gales. The explanation is the propinquity of Foxe Basin with its vast ice fields which react upon the climate like a gigantic refrigerator. Especially when the wind is northwest, we catch the devil. Few days during the collecting that I was not forced to use a Sterno can for a hand warmer in order to keep on working, and I'm tolerably well inured to that. And that wasn't only a month ago — yesterday no later, and today it wouldn't come amiss.

And yet thru it all we have the birds, their courting, nest-building, rearing of young and bloom of shy little prostrate and impoverished plants — a pitiful thing in a way, in their valiant struggle for fruition, in not only a short summer, but a hard one.

DEPARTMENT OF THE INTERIOR
CANADA

NORTH WEST TERRITORIES AND YUKON

OTTAWA

And too, notwithstanding the wretched climate, I have witnessed some wonderful events. A book could do justice alone to the details. As a bird migration route and a breeding grounds it eclipses, by far, anything I have ever beheld in the past. Think of a region swarming with Blue Geese — during the migration geese of all kinds, and Brant —, and around camp I have such birds commonly nesting as Red Phalarope, White-rumped Sandpiper, Parasitic and Long-tailed Jaeger, Black-bellied and Semipalmated Plover, Ruddy Turnstone, King Eider, Black-throated Loon, Sabine's Gull and — a little removed, <u>Blue and Snow Geese</u>! Yes, indeed, it has been a great experience, especially during the migration, with thousands upon thousands of these birds and others swarming over the snow-free patches of tundra on their way to higher latitudes. For music, we depend as usual, upon the abundant Bunting and Lapland Longspur, the darlings of the lonely wastes.

I have added several new species to the Baffin Island list, names which I have carried around in anticipation before blank spaces since 1923! And as for collecting, it is a paradise for northern birds. And by the way, I have among other things discovered the real Baffin Island migration route of the Purple Sandpiper — it is right past Camp Kungovik! — by the tens of thousands, compact flocks of hundreds, so closely ranked on the restricted areas of bare ground at time of passing that a single charge would desolate a half a hundred future homes at once.

Well, it remains now to escape this wretched country, for which we depend entirely upon the disappearance of the ice in the southern part of the Basin. I hope to see it go soon now. In two days we embark upon the river for the sea, bid adieu to Camp Kungovik — I hope forever, and begin the long voyage that will eventually bring me to home and friends again. From the basin our route lies thru a partially unexplored chain of rivers and lakes thru the heart of Foxe Land to Hudson Strait. Luckily, I know more than the half of it from explorations and mapping conducted last fall, so may now lay my plans, as before leaving Dorset, to the very best advantage. Hope to make Dorset in about three weeks, then the big ship, civilization and all the old friends once more.

Adios, Senor
[illegible]

P.S. The camp is named from the Eskimo for Blue Goose.

## Appendix 2:

Source: National Archives of Canada. MG 30 B40 Vol. 15 File I. Also: Department of the Interior, North West Territories and Yukon, file 6652.

### Minutes of the meeting held to discuss the matter of the final disposition of the Baffin Island Natural History Collection.

A meeting was held in the Department of the Interior, Ottawa, on 20 November 1929, to discuss the final disposition of the Baffin Island Natural History Collection. Those present were W. W. Cory, Deputy Minister, Department of the Interior; O. S. Finnie, Director, N.W.T. and Yukon Branch; J. Harkin, Commissioner of Dominion Parks; C. Camsell, Deputy Minister of Mines; P. A. Taverner, Ornithologist; J. D. Soper.

The collection consisted of mammals and birds with their nests totalling 512 catalogue entries. Twenty-two bird skins were of the "Blue Goose". The collection also contained eleven valuable sets of eggs of the "Blue Goose". During the meeting the following recommendations were made:

(1) That the entire collection of Baffin Island specimens shall go to the National Museum of Canada to be unpacked and stored.

(2) That the National Museum shall receive one set of Blue Goose eggs, and that one set each be presented to the British Museum, and the National Museum of the United States. It was further recommended that the department of the Interior retain one set of Blue Goose eggs, with a further suggestion that sets be laid aside for the Banff and Jasper Museums and for a possible future museum at Fort Churchill.

(3) That the National Museum of Canada be presented with the remaining specimens. In assuming ownership of this material, the National Museum will undertake to prepare, in a suitable manner, all specimens which are now in an unfinished condition, and make them available for study as soon as possible.

(4) That such specimens and sets of eggs presented to the National Museum of Canada, as may be regarded by it as duplicate, or surplus material, may be disposed of in exchange with other museums for desirable study material not now contained in the National Museum or is inadequately represented in the National collection.

(5) That Mr. Soper and Mr. Taverner be entrusted with the unpacking and storage of the Baffin Island collection within the National Museum of Canada.

(6) That no material in the Baffin Island collection be disposed of by the National Museum until Mr. Soper has pursued the study of it to his satisfaction, in relation to the preparation of scientific papers dealing with the fauna of Baffin Island.

(7) That the National Museum be provided with a copy of Mr. Soper's field catalogue covering the natural history specimens from Baffin Island, to be used in checking in the specimens, and as an aid to proper cataloguing of this material in the national register devoted to such acquisitions.

The final paragraph was about arrangements for recovering cases from Camp Kungovik, where they were stored, sometime during the next year (1930), and having them taken by Eskimos with dog teams to Cape Dorset for loading on *S. S. Nascope*.

## Appendix 3:

End Note 97 of Chapter 14 refers.

**From: R. M. Anderson**

**To: Dr. Charles Camsell**

***Memorandum***

***Subject: Status of Division of Biology, National Museum of Canada***

This memorandum consists of 17 typed foolscap pages of 23 numbered items each with an underlined heading, and one page of a Summary of Conclusions. Here follow some titles selected from this long and rather repetitive memorandum. Anderson's main points were clear enough:

(9) *Recent flagrant disregard of rules, orders, and customs*

"Further than that, I stated that I am myself a qualified ornithologist, working on birds professionally, and am now working on an important ornithological report, and wish pertinent specimens to be available, and to know where they are."

(10) *Present lack of discipline is becoming a public scandal*

"The bird collection of the National Museum for a considerable time has been used more for the gratification of personal vanity and as a factor in A.O.U. (American Ornithologists' Union) politics, than for the advancement of ornithological science in Canada."

(12) *Should the museum keep up policy of Divisional responsibility?*

"The chief apparent reason for intrigue in the Division of Biology, and indirectly affecting other sections of the National Museum, has been to get a separate Division of Birds established, a purely one-man affair, as Mr. Taverner has always worked strenuously, directly or in an underhanded manner, to keep anybody from getting on the Museum staff who has any knowledge or interest in scientific ornithology."

(14) *Qualifications of ornithologists of National Museum*

These paragraphs attempt to show that Taverner's education was so elementary that "much of Mr. Taverner's ornithological publications would hardly have been worthy of the Department if he had not had a qualified scientific ornithologist back of him." (page 6) Continuing, Anderson showed that Taverner's training in science did not even reach junior matriculation as understood in Canada. He also had a disability in speaking in public (page 7).

(15) *Ornithological qualifications of the Chief of Division*

2 paragraphs of his c.v. in the field of ornithology. "… there seems to be no just grounds for superseding his directional capacity in ornithology at the National Museum of Canada."

(16) *Inconsistency shown in present agitation for changes*

" … largely through the efforts of the Chief of the Division the Department of the Interior allowed the specimens from Mr. Soper's last two Baffin Island expeditions to be "deposited" in the National Museum of Canada for *safety* until Mr. Soper could return and work up the reports. Mr. Taverner, as a supposed friend of Mr. Soper received some of his data and all the specimens for examination in a privileged capacity, skimmed the cream from Soper's investigations and published them under the name of Taverner without informing Soper about the fact, although Soper was working in Ottawa at the same time. Mr. Taverner also began to peddle the Soper collections away without consulting either Mr. Soper or the Chief of the Division. Soper's two reports have not yet been published." (page 10) [But see Appendix 2 which shows the official arrangements made for the disposition of the Baffin Island collection. Soper and Taverner were present at this discussion and agreed to the recommendations made.]

(19) *Exchanges, gifts or loans of scientific specimens should be checked by a reviewing officer as with other financial transactions involving Government property.*

(20) *Active endeavours to disrupt the National Museum organization*

"Mr. Taverner has for at least twenty years been one of the most persistent critics and trouble-makers on the museum staff. Every chief, director, acting director, or other official above him has been consistently knocked, plotted against, and undermined as far as his limited influence goes. The administration of the National Museum has been receiving undesirable publicity from one end of North America to the other, as I know very well from personal knowledge and reliable communications. Mr. Taverner has never had enough scientific training to carry on

advanced work, and with not enough to keep him busy, has had plenty of time for intrigue."

(21) *Lack of control of publications by members of the staff*

"Recently in looking over certain technical publications by members of the staff of the Division of Biology, I noted that two major articles were published during 1935 as ornithological contributions, and that both of them were rank plagiarisms."

Anderson gave their titles as A. "Continental Land Masses and their Effects upon Bird Life" by P. A. Taverner in *The Condor* 37, Number 3: 160-162 (1935); (page 13). B. "Variability in size of gulls" by P. A. Taverner in *The Condor* 37 Number 4: 215-216 (1935). The whole of his paper, Anderson said, was cribbed from a lengthy dissertation by the late Bernard Hantzsch entitled 'Beitrag zur Kenntnis ger Vogelwelt des nordostlichsten Labradors', Journal fur Ornithologie, Leipzig, Volume 58, 1909, page 324." Anderson explained that "Our departmental ornithologist would not have lifted it directly from the original German text, but it happened that M. B. A. and R. M. Anderson had taken the trouble to translate and annotate the whole paper, the same being published in serial form in *The Canadian Field-Naturalist*, January 1928 to March 1929." The section from which Anderson accused Taverner of cribbing appeared in translation in this journal in May 1929, Volume 42 under the section about the Glaucous Gull.

At the end of the Summary of Conclusions Anderson signed the memorandum:

Respectfully submitted
R. M. Anderson
Chief of Division of Biology
National Museum of Canada

# End Notes

## Abbreviations

| | |
|---|---|
| AOU | American Ornithologists' Union |
| BOU | British Ornithologists' Union |
| CMN | Canadian Museum of Nature |
| GSC | Geological Survey of Canada |
| MTRL | Metropolitan Toronto Reference Library |
| NAC | National Archives of Canada |
| NMC | National Museum of Canada |
| PABC | Provincial Archives of British Columbia |
| ROM | Royal Ontario Museum |

## Chapter 1

1. Birth Certificate of Percy Algernon Fowler. Registration No: 1875-05-022716. Date of birth: June 10, 1875. Place of birth: Guelph. Name of father: Edwin Fowler. Name of mother: Emily E. Buckley. Place of birth of father and mother: not recorded. Father's occupation: Principal. Mother's occupation: not recorded. The age of each parent was not recorded.
2. Information from baptismal certificate preserved at St. George's Anglican Church, Guelph. Date of baptism: 7 July 1875. His mother's name was given as Emily Ellen Buckley, his father's occupation as school teacher, and their place of residence as Guelph.
3. P. A. Taverner, "Biographical Outline", compiled 1942. Canadian Museum of Nature (CMN) Percy Taverner Ornithology Archive, hereafter CMN.
4. W. L. McAtee "Percy Algernon Taverner, 1875-1947" *The Auk* 65 (1948): 85-106. McAtee obtained family information from Taverner's own "Biographical Outline" and from reminiscences sent him by Taverner's half-sister, Mrs. John McLeish. I have not been able to trace this letter, or letters. It is possible that any information about Taverner's parents and first years was destroyed by McAtee since the Taverners remained silent about Percy's father.
5. Carolyn Cox *Toronto Saturday Night* 4 November 1944.
6. Madge Macbeth, in column entitled "Over My Shoulder", *Ottawa Citizen* 12 July 1958. This was the first of four articles.
7. She was born on 22 February 1854 at Prestwick, Lancashire. Her mother was Mary Heyward Buckley, nee Hind. In the Chicago directories of the period 1870-1874 several other Buckleys were shown who were born in England, but none called George. An index of death notices in all ten English-language Chicago newspapers, 1837-1889, failed to show any George Buckley.
8. Information from a Chicago directory of 1871, which contained a partial listing of the U.S. Census of 1870, gives no other given name for Edwin Fowler.
9. Hugh Douglass "An Account of Some of the Private Schools of Guelph, 1827-1900". Unpublished ms.1960, Public Library, Guelph. The author was president of the Guelph Historical Society in 1960.
10. Letter from Registrar's Office, University of Oxford, 9 July 1984.
11. City of Guelph Assessment Rolls, 1874. Also Guelph Land Registry Office, 1874, plans 175/6 lot no. 1 book 7.
12. A new marriage act came into effect on 1 July 1874. Instead of a marriage licence, which required the publishing of the banns of marriage, a certificate could be obtained by one of the parties swearing an affidavit that there was no legal cause to prevent the solemnization of the marriage. Since Emily Buckley was under twenty-one years of age she had to swear an affidavit that her father and mother were dead and that there was no one with authority to given consent to the marriage. Province of Ontario, C.6, An Act Respecting the Solemnization of Marriages, 1874. The Guelph *Daily Herald* published an official notice about the new marriage certificates issued by authority at the Guelph Divisional Office. It stated that no bondsmen were required.
13. Educational advertisement printed in the *County of Wellington Atlas*, published 1877, as quoted in Douglass "An Account", page 10.
14. Greata Mary Shutt *The High Schools of Guelph* (Guelph: The Board of Education for the City of Guelph 1961), page 92. There is a photograph of the house used by Fowler's Academy on page 93.
15. Douglass "An Account" page 10.
16. Murray D. Edwards *A Stage in Our Past* (University of Toronto Press, Toronto, 1968).
17. Taverner to H. M. Laing, 8 March 1947. Provincial Archives of British Columbia (hereafter PABC) Laing Papers.
18. Fanny A. Sharman to H. M. Laing, 2 July 1947. PABC, Laing Papers.

## Chapter 2

1. A stock company was a resident company the members of which would put on a variety of plays during the season, often with well known actors and actresses coming to play the star roles. Emily was a member of the "ballet" which referred to the "extra" men and women members of the company who played walk-on parts as required.
2. Ida Van Cortland, an address given to the University Women's Club of Ottawa about 1918. Taverner Collection, Arts Department, Metropolitan Reference Library, Toronto (hereafter MRLT). The advantage of training with a stock company was the variety of parts played and broad range of experience gained. With a touring company a smaller repertoire of plays was presented and so members of the company played fewer parts. Based on Kathleen Fraser "Theatrical Touring in Late Nineteenth-Century Canada: Ida Van Cortland and the Tavernier Company 1877-1896". Unpublished Ph.D. Thesis (University of Western Ontario 1985).
3. The Company alternated between Halifax and St. John's, Newfoundland.
4. His family lived in Toronto and Hamilton in the 1870's. Young Albert was encouraged to get a degree in civil engineering, but he preferred to spend time on amateur college productions. For an explanation of why the son spelt the family name as Tavernier, see note 8 below.
5. Notice in the *Dramatic Mirror*, 25 June 1881. "Albert Tavernier, of the Madison Square Theatre Company,

and Ida Van Cortland, of W. H. Powers' Galley Slave Company were united in marriage by the Rev. Henry Wosse, at his residence ... on the evening of June 11." Kathleen Fraser, personal communication, 24 May 1984, quoting *Dramatic Mirror* of 25 June 1881.

6. W. J. Florence was the founder of the Order of the Shrine. Hence *The Mighty Dollar* was connected with the Masonic Order. Fraser, Thesis, 21. See note 2 above.
7. Same 23.
8. McAtee "Taverner" 94. For professional reasons Albert always spelt his name with an *i*, but the rest of the family spelt it without. Percy later dropped the *i* in his name. Writing in 1940 to another Taverner in Alberta he explained that the name Taverner was only his by adoption and that he had no genetic claim to it. On the question of how the name should be pronounced he wrote, "Our family tradition is 'Ta-verner'." PAT to Jessie Taverner, 16 April 1940. Taverner Collection, Theatre Department, Metropolitan Toronto Library.
9. P. A. Taverner "Biographical Outline" 1, see Chapter 1 note 3; McAtee "Taverner" 86-87; 94. See Chapter 1 note 4.
10. Reproduced in a newspaper article. Madge Macbeth the *Ottawa Citizen* 9 August 1958 in column called "Over My Shoulder". Unfortunately it has not been possible to find the original photograph from which this was made. At that time it had probably belonged to his sister Mrs. Ida McLeish.
11. For a detailed account of the Taverniers' Company see Fraser chapters 2 and 3.
12. Itinerary for Maritime Provinces 1883-84 in Fraser pages 186-192; Ontario and Great Lakes 1884-1985 in Fraser pages 195-200.
13. Fraser, Thesis, page 105-106.
14. McAtee page 94.
5. Same reference.
16. Purchased from the Crown by a grant of 19 December 1877. This stated that Joseph William Taverner, of the City of Toronto, in the County of York, Professor of Elocution, purchased for sixty-one dollars a tract of land of fifty-six acres composed of Gibraltar Island, in Lake Muskoka. Document in Land Registration Office, Bracebridge, Ontario.
17. This was a deed of sale between Henry W. Taverner, gentleman, of San Francisco; Joseph E. Taverner, piano tuner, of Mount Vernon, N.Y.; Mary Ann Taverner, widow, of San Francisco; Isabel Power; Frances Graham; Theresa Lindeman; Clara Preston and Florence Knill. The last five were married women whose husbands signed the document with them. Presumably these five were daughters of Joseph William Taverner, while Mary Ann was a widowed daughter-in-law. The five hundred dollars would be divided among these eight people. See note 50 below for Fraser's analysis of the account books kept by the Tavernier Company.
18. Albert and Ida started a guest-book (also referred to as a log-book) for the cottage at Point Coo-ee on Gibraltar Island. This was their first entry. Percy had just turned 11 years old.
19. Ontario Birth Certificate no. 1887-05-040130. She was named Ida Clara. Clara was the name of Albert's sister in San Francisco, but the family spelt it Clare. Her mother's name was given as Ida Fowler. Places of birth of mother and father were not recorded. Albert Tavernier's occupation was shown as "salesman" and not actor. A prejudice against the acting profession still existed at that time.
20. The Knill family was well known in the area around Markham and Stouffville in the nineteenth century. Information supplied by the Markham Museum.
21. Fraser, Thesis, chapter 3.
22. Fraser, Thesis, pages 108-109.
23. Percy had suffered from a stammer in his speech from as early in his life as he could remember. It must have been a hindrance to him because as soon as he came to Detroit to live in 1904 he took a course at a school for stammerers though without much success. His stammer remained with him all his life. P. A. Taverner to J. H. Fleming, 7 December 1904. Royal Ontario Museum Archives, Percy Taverner Papers, hereafter ROM.
24. Information obtained from Anna Clinton *History of Ann Arbor Public Schools* (Ann Arbor 1951); Lela Duff *Pioneer School. Some Chapters in the Story of Ann Arbor High School* (Ann Arbor 1958).
25. On the back is written "Family photo – 1889 – Percy 14 – Ida 2 – Gibson — Ann Arbor". Presumably this was written by Ida Van Cortland. There is another version of this group with Ida looking away from the camera, but with Percy smiling a little. Taverner Collection, Theatre Department, Metropolitan Toronto Library.
26. There is a very clear black-and-white photo of the school taken by R. M. Scadin at this period and reproduced in *Art Work of Washtenaw County* (Chicago 1893).
27. Copies of the Annual Catalogue and the Annual Year Book (*Omega*) covering this period are preserved in Michigan Historical Collections, Bentley Historical Library, University of Michigan.
28. Ann Arbor High School, Catalogue 1891 page 11.
29. Ridicule by direct imitation of his stammering would be the usual way, but also by a sharply spoken question such as "What's your name boy?" "What does your father do?" When the unfortunate boy tried to stammer the answer it would provoke a burst of laughter. If he remained silent or failed to say anything coherent he might get a slap on the cheek with the back of a hand. From seeing this happen at junior school.
30. Taverner "Biographical Outline" 1, CMN. Robert Henry Wolcott studied at the University of Michigan where he received a B.S. degree in1892, and an M.D. degree in 1893. He followed a career in biology and in summers of 1893 and 1894 was hired to make a survey of fish in Michigan waters. In the following year he joined the Department of Zoology at the University of Nebraska where he continued his graduate studies. Obituary in *The Auk* 52: 130-131, 1935.
31. Taverner "Ornithological Notes" books 1-4 (May 1892–November 1903) 4. ROM.
32. Same, 5-6. There was already a contradiction showing in Percy's notes between his scientific desire to learn to identify each species accurately by collecting specimens for study "in the hand", and his artistic appreciation of their plumage and movements. This contradiction was never fully resolved.

33. In using Taverner's notes *the bird names he used at that time* have been retained in order to show what he called a particular bird *then*. To aid the reader the names of species given in the current *American Ornithologists' Union Check-list* (AOU) have been added. At this time Percy was still in the process of learning the check-list names in place of some vernacular names he had grown up with.
34. He still had not seen one by 1906 when he heard from Norman A. Wood, taxidermist at the Museum at Ann Arbor, that a Sycamore Warbler, the colloquial name for the Yellow-throated Warbler, had been collected. Taverner to N. A. Wood, 29 May 1906. ROM.
35. Fraser, Thesis, page 108.
36. It is possible that the school reassembled late that fall on account of an exceptionally late harvest, and would then make up the last weeks at the end of the school year. Most children in that period were required to help with the harvest, and the summer holiday might continue late into the fall.
37. Taverner "Ornithological Notes" 25 April 1894, ROM.
38. For an account of the building of the Royal Opera House, Guelph, and its management under Albert Tavernier see Wayne Fulks "The Royal Opera House", *Guelph Historical Society Publication* 22: 49-69 (1983). A shorter version of Fulks' article was published in *Theatre History in Canada* 4: 41-56 (1983).
39. Taverner "Ornithological Notes", Guelph 3 May 1895, ROM.
40. Log-book of cottage at Point Coo-ee, Gibraltar Island, 1895. I am grateful to Mr. David J. McLeish, who possesses the log-book, for letting me read it . Note 18 above refers to the origin of the log-book.
41. Same 1895.
42. Carolyn Cox "Name in the News" *Saturday Night,* Toronto 4 November 1944 wrote: "Before graduating from High School Taverner went back to Guelph where his stepfather had taken on the management of the New Opera House..." This implies that he later returned to Ann Arbor in order to graduate. This would have been possible in the first half of 1895, but from June 1895 onwards he was at Beaumaris and after that on tour with the Company. A disastrous fire at Ann Arbor High School on 31 December 1904 destroyed all the student records. Nor does any copy of the student year book for 1893-1894 exist in Ann Arbor libraries — the year that Percy should have graduated. There is no sign of his name in the student Year Book for 1894-1895. Therefore the precise meaning of the words "before graduating from High School" are uncertain.
43. Fraser, Thesis, pages 272-274.
44. Taverner "Ornithological Notes" Winnipeg 21 and 24 October, 1895, ROM. The Greater Prairie-Chicken was reported to have been fairly common in southern Manitoba in the 1890s. W. Earl Godfrey *The Birds of Canada* (Ottawa 1986) page 163. Taxidermists were more likely to call game birds by hunters' names than by ornithologists' names at that time, and it could have been a Sharp-tailed Grouse. However, they were useful people for Percy to visit whenever the train drew into town. Because taxidermists had specimens of locally killed birds in their shops local hunters congregated there as well, and exchanged bird news.
45. Taverner "Ornithological Notes", Huron, South Dakota. 13 December 1895, ROM.
46. Taverner "Ornithological Notes" Preface, page 2 note added under date 3 February 1896, ROM.
47. Taverner "Ornithological Notes", made at Ann Arbor 8 February 1896, ROM. Other ornithologists and wildlife artists have found fault with Audubon's paintings for being stiff, unrealistic, disproportionate, and such reasons. But it is important to remember that he was painting for patrons who would pay well for large-scale representations of birds they could never hope to see. Audubon had to work under great difficulties in the field collecting specimens from which to paint.
48. Taverner "Ornithological Notes", Guelph 6 May and 4 June 1896, ROM.
49. Fraser 277, quoting from *Dramatic Mirror* 8 August 1896.
50. From Kathleen Fraser's analysis of the account books kept by the Tavernier Company it is clear that what money the Company made by touring was lost in Albert Tavernier's two ventures as an actor-manager in Jackson and Guelph. The Taverniers' weak financial position in 1895, when leasing the Royal Opera House, Guelph, was clearly losing money, may have prevented Percy from entering the University of Michigan, even if he had the necessary qualifications. The accounts also show numerous loans from Ida to Albert without any record of being repaid. Fraser page 110. It may also have led to the document signed by Albert Tavernier deeding Gibraltar Island to Ida Van Cortland in 1900. See Fraser "Theatrical Touring", page 110.
51. Fraser, same, page 10 note 14.
52. These were the property of a Mr. Lucas, comprising about thirty skins among which Percy mentioned: Moa; Kea; Maori Hen; Huia. He also mentioned that Lucas owned "a fine illustrated work by Sir W.L. Buller which describes their habits very minutely and graficaly" [graphically]. Taverner also made pen sketches of the difference between the bills of the male and female Huia.
53. Taverner was twenty-one years old and McIlwraith was seventy-two. In his "Ornithological Notes" under that date he wrote that McIlwraith mentioned a bird he called a Bay-winged Bunting and another he called the Bay-winged Sparrow. These, Taverner said, were local names for the Dickcissel and the Vesper Sparrow.

## Chapter 3

1. This was probably James Grand who bought an island near to Gibraltar subsequently called Grandview. Joyce I. Schell *The Years Gone By. A History of Walker's Point and Barlochan — Muskoka 1870-1970* (Bracebridge 1970) page 65.
2. James Henry Fleming, 1872-1940, only son of James Fleming of Aberdeen, who came to Canada from Scotland and established a pioneer seed-growing business on a three-acre plot at Yonge and Elm Streets. J. H. Fleming was educated in Toronto at the Model School and at Upper Canada College. His interest in building a study collection of birds began in 1886 when he was fourteen years old, ten years before he met Taverner. There is no biography of

Fleming, but a useful short source exists in *The J. H. Fleming Memorial Program, November 5, 1940* The Brodie Club (Toronto 1940) 29 pages typescript. ROM, Brodie Club Papers. Also L. L. Snyder "In Memoriam: James Henry Fleming" *The Auk* 58: 1-12 (1941).

3. Taverner "The Old Taxidermy Shop and Point Pelee Days" in *The J. H. Fleming Memorial Program*, ROM, Brodie Club Papers, November 1940.
4. Taverner to L. L. Snyder, 4 October 1940, CMN. On Lambe see obituary *Globe and Mail* Toronto, 5 December 1941; J. L. Baillie to W. L. McAtee, 8 October 1947. University of Toronto, Fisher Rare Book Library, Baillie Collection.
5. Taverner to Snyder, 4 October 1940, CMN.
6. T. M. Shortt "The Fleming Collection" in *The Fleming Memorial Program, ROM.* For example Fleming had two specimens of the Large-billed Finch (*Geospiza magnirostris*) taken on Abingdon Island, in the Galapagos in 1897. Charles Darwin had taken the type specimen from nearby Charles Island. Shortt 17.
7. Taverner "Old Taxidermy Shop ..." page 27.
8. A complicated story to unravel. Taverner wrote to W. F. Webb, editor of *The Museum*, announcing that he had taken a Wheatear at Beaumaris on 25 September 1894 and that it was identified as such by R. Ridgway. This was published in *The Museum* 2: 16 (1895). Covert wrote to Taverner that he had sent it to Ridgway who identified it, and that he had deposited it with the Smithsonian. Covert then wrote to R. H. Wolcott at the University of Nebraska that he had taken a Wheatear near Ann Arbor on 4 October, and that an account of this would be appearing shortly. A. B. Covert "The Wheatear in Michigan" *The Nidiologist* 2: 42-43 (1894). For a review of the status of the Wheatear in Ontario see Jon C. Barlow "Status of the Wood Ibis, the Fulvous Tree Duck and the Wheatear in Ontario" *The Canadian Field-Naturalist* 80: 185 (1966).
9. Taverner, letters in *The Gravenhurst Banner* 28 October and 10 November 1896.
10. Taverner "Old Taxidermy Shop ..." page 26. Taverner's sister, writing to McAtee after his death, mentioned his sailing on Lake Muskoka. "He was wonderfully adept at small boat handling, could literally sail anything. When in his early 'teens, he converted a little 14-foot row-boat of his into a sail-boat, decked it over, put in a centre board ... and went out in it in any gale." McAtee *Auk* 65: 97 (1948).
11. Taverner to [Sir] Peter Scott, 22 September 1938. CMN.
12. Taverner "Ornithological Notes" 7 December 1896; also 23 May 1898.
13. Percy told it to his wife Martha, who told it to a long-time friend, Mrs. Jean York, when she was a widow living in Ottawa. Mrs. York to author in a tape recorded interview, Ottawa, 16 September 1984.
14. Taverner received instruction in taking photographs from W. A. Anderson who had a cottage in Beaumaris. The only photo of Percy's to survive from this period was pasted on the outside of the notebook and shows a girl of about sixteen, wearing a short sleeved summer dress with cotton stockings. She is seated on a rock beside a lake with her feet in the water. She is looking directly at the camera, and is close enough to show a slight smile. ROM Taverner Papers.
15. His mother's address was given in the log-book of their cottage in 1899 as Port Huron. There is reasonable proof that Percy was in Port Huron at least by March 1899 because at the meeting of the Michigan Ornithological Club in mid-April "Mr. Percy Tavernier, Port Huron, Michigan" was elected to active membership of the club. Since he arrived in Toronto at least by mid-December 1898 it seems very probable that he joined his mother and sister in Port Huron for Christmas.
16. There were three architects in Port Huron at the turn of the century, the most important being John C. Kaumeier who had designed many of the principal buildings since 1875. George L. Harvey was not well known. His office was at 201 Huron Avenue, an easy walk from where Percy boarded. At this time the population of Port Huron was around 20 000, while Sarnia, across the river, was about 7000 and growing.
17. McAtee, *The Auk* 65: 95, 1948).
18. Ernest Seton-Thompson to Taverner, 18 March 1900. ROM.
19. Clipping from *American Ornithology* sent to Taverner by A. G. Lawrence of Winnipeg. Lawrence to Taverner, 30 October 1942, CMN.
20. John Macoun *Catalogue of Canadian Birds* (Ottawa 1900-1904). Published in three parts. Part. I Water Birds etc. (1900); Part II Birds of Prey etc. (1903); Part III Sparrows, Warblers etc. (1904).
21. John Macoun to Taverner, 15 July 1900. ROM. The Wilson's Petrel was recorded by Taverner in his "Ornithological Notes" 18 December 1897. It belonged to Dr. Cornell of Gravenhurst and was found dead or killed at Gull Lake, Muskoka "a few years ago", ROM.
22. William Dutcher to Taverner, 1 December 1902, ROM. Dutcher was treasurer of the AOU at that time. Fleming was responsible for nominating him.
23. U.S. census returns St. Clair County, Port Huron Ward, St. Clair Street, number 513.
24. McAtee, *The Auk* 65: 95. (1948).
25. Ida Van Cortland "Address given to the Ottawa Drama League" about 1918, page 10. Arts Department, MTRL, Taverner Collection.
26. Taverner "Biographical Outline" page 2, CMN.
27. Letter Taverner to Fleming, 9 April 1904 on notepaper with printed heading, Independent Order of Foresters, ROM.
28. There were four "Courts" of the Independent Order of Foresters listed in the St. Clair County Directory, 1899-1900. It is possible that Ida Van Cortland started working for the Foresters while living in Port Huron at some time between 1897 and 1902. In the agreement drawn up between Albert and Ida Tavernier dated February 1900, in which he released to her and her heirs all his rights to the Island of Gibraltar, his address was given as Detroit, and hers as Port Huron.
29. Letter addressed to Taverner at Port Huron dated August 1901, ROM.
30. Taverner to Fleming, 11 December 1902, in which he said that he was attending night classes in water-color drawing at the Chicago Institute of Art "this winter",

while last winter (1901-1902) it was sculpture, just for recreation, ROM. A notebook of 34 water-color sketches has survived from the period 1902-1905. The subjects are wild flowers, butterflies and insects. Property of Mrs. Marte Kent. I am grateful to Mrs. Kent for allowing a set of coloured reproductions to be made for presentation to the Taverner collection in the Archive of the ROM.

31. Taverner notebook "Systematic Bird List and Migration Notes" 1893-1900, ROM.
32. Taverner "Biographical Outline" 2, CMN.
33. McAtee *Auk* 65: 96 (1948).
34. Taverner "Ornithological Notes" 3 May 1903, ROM.
35. Same 15 March, ROM.
36. Same 12 April, ROM.
37. Same 3 May, page 140. Then follow 7 more pages of sustained writing on the last of the Passenger Pigeons, how and why they would never be able to breed again. It is a moving threnody on the disappearance of this once prolific species. ROM.
38. Same 3 May, page 147, ROM.
39. *Dr. J. A. Allen* (1838-1921). Curator of Birds and Mammals at the American Museum of Natural History from 1885. A founder of the American Ornithologists' Union in 1884 (incorporated 1888). Special concern for problems of nomenclature and updating the AOU's *Check-list of North American Birds. F. M. Chapman* (1864-1945). Assistant to Allen at American Museum and Curator of Birds. Distinguished museum-builder and educator. Editor, *Bird Lore*, author *Handbook of Birds of Eastern North America* 1906 and later editions. *C. H. Merriam* (1855-1924). Chief Division Ornithology and Mammology United States Department of Agriculture 1886; chairman AOU committee on migration and geographical distribution. *Dr. T. S. Palmer* (1868-1955). Assistant Chief to Merriam 1896-1902. Worked for bird protection through legislation; collected information on wildlife conservation. Secretary AOU 1917-1937.
40. Taverner "Ornithological Notes" 3 May 1903, 151, ROM.
41. Same 8 June, pages 163-168, ROM.
42. Same 27 June, ROM.
43. Information from Frank M. Chapman *Autobiography of a Bird Lover* (N.Y., 1933) page 173.
44. Fleming to Taverner, 26 May 1903, ROM.
45. Taverner "Ornithological Notes", 24 October 1903, 183-190, ROM.
46. Taverner to Fleming, 8 November 1903. Taverner said he would like to put them into the form of a paper to be read at the AOU meeting being held at Philadelphia from 17-19 November 1903. ROM.
47. J. A. Allen to Taverner, 1 November 1903, ROM.
48. Fleming to Taverner, 20 November 1903, ROM.
49. T. S. Palmer to Taverner, 25 November 1903, ROM.
50. J. A. Allen to Taverner, 20 December 1903, ROM. This was a frank letter which might have silenced a less persistent man than Taverner. Allen himself had put forward the same ideas as hypotheses ten years previously in *The Auk* 10: 48 (1893).
51. Same, 10 January 1904, ROM.
52. Same, 18 February 1904, ROM.
53. *The Auk* 21: 322-333 (1904). The article served to bring Taverner to the notice of the readers of *The Auk*. He sent a copy of it to A. R. Wallace in England and received a post card back which read, in part: "I agree with you generally, but I do not believe in any *instinct* in the matter. My latest view is given in my Studies Scientific and Social volume 1, page. 502, 'The Migration Instinct'. Wallace to Taverner, 31 August 1904. (This card was discovered in a copy of the 1898 edition of Wallace's *Malay Archipelago* given to Erling Porsild after Taverner's death. I am grateful to Porsild's granddaughter, Jennifer Lumsden, for this information.) Professor William Rowan of the University of Alberta was carrying out experiments on bird migration in the 1920s which culminated in his important book *The Riddle of Migration* (1931). In a short overview entitled "Fifty Years of Bird Migration" he mentioned Taverner's discussion in his article of the reason why birds leave what appears to be a satisfactory environment and take the risk of travelling north to breed. "His discussion is lucid and full, and present-day opinion would largely agree with him." At the end of his article Rowan acknowledged that his own indebtedness to Taverner would be difficult to estimate. In F. M. Chapman and T. S. Palmer editor: *Fifty Years' Progress of American Ornithology 1883-1933*. (Lancaster, Pennsylvania. Pages 51-63.) See also Taverner to A. Wetmore, 20 January 1932, CMN.
54. T. S. Palmer to Taverner, 25 November 1903, CMN.
55. Taverner "Journal of Bird Observations", 28 November 1903, 15-18. ROM.
56. Taverner to Fleming, 8 November 1903, ROM.
57. Taverner to Fleming, 8 November 1903; Taverner to Fleming 9 April 1904, ROM.
58. Taverner to Fleming, 8 November 1903; 20 January 1904, ROM.
59. J. Dwight, Jr., to Taverner, 22 February 1904, ROM.
60. Taverner to Fleming, 20 January 1904, ROM.
61. N. A. Wood to Taverner, 24 January 1904, ROM. Wood became curator of birds at the museum in 1911.
62. See H. M. Mayer and R. C. Wade *Chicago: Growth of a Metropolis* (Chicago 1969).

## Chapter 4

1. Taverner Journal of Bird Observations, 6 April 1904, ROM.
2. N. A. Wood "Discovery of the Breeding Area of Kirtland's Warbler"; and C.C. Adams "The Migration Route of the Kirtland's Warbler", *Bulletin Michigan Ornithological Club* 5: 3-13; 14-21 (1904). Charles Adams was Curator, University of Michigan Museum.
3. Taverner to Fleming, 9 April 1904, ROM.
4. P. A. Taverner "A Discussion of the Origin of Migration" *The Auk* 21: 322-333 (1904).
5. P. A. Taverner "The Origin of the Kirtland's Warbler" *Ontario Natural Science Bulletin* (Guelph) 1: 13-17 (1905). For status in early 1980s see R. B. Payne *A Distributional Checklist of the Birds of Michigan* (Ann Arbor 1983).
6. An announcement by Barrows asking for information for inclusion in the Bulletin on the birds of Michigan which he was compiling was printed in the *Bulletin Michigan Ornithological Club* (March 1904) page 26.

7. Taverner Journal, 1 May 1904, ROM.
8. Taverner Journal, 30 May 1904, ROM.
9. Taverner Journal, 16 April 1904, ROM.
10. Same as 9.
11. Taverner to Fleming 7 December 1904, ROM.
12. Taverner to Fleming 26 June 1904, ROM.
13. Taverner to Fleming, 4 May 1905, ROM.
14. A copy of the program of the Saint-Saens Concert held in the Light Guard Armory, Detroit, on the evening of 12 December 1906 with Martha Hohly's name on it has been preserved in the Music and Drama Department of the Detroit Public Library.
15. In the Detroit City Directory for 1902 Martha Hohly is listed as "teacher of music, Michigan Conservatory of Music". Ida C. Tavernier is listed as "music teacher" for the first time in the 1907 Directory.
16. Fleming to Taverner, 8 February 1906, ROM. The Ben Greet Players performed Twelfth Night in the Elizabethan manner at the Detroit Opera House on 31 May 1905. Report in the Burton Special Collection, Detroit Public Library. Taverner writing to Fleming 22 March 1907 mentions "great feast of Shakespearean production" they had been enjoying. "A succession of good things have come on top of each other and we felt that we could not miss them. Among them was Annie Russell in Midsummer Night's Dream. This was the most satisfactory performance I ever saw given. The setting was good and the mechanical effects, lights etc. were almost perfect without once overshadowing the kernal of the work."
17. Taverner to Fleming, 13 April 1909, ROM.
18. Karel Wiest, Taverner's step-son, in personal communication at Detroit January 1984.
19. Taverner Journal, 2 October 1904, ROM.
20. Taverner Journal, 5 August 1905, ROM.
21. Taverner Journal, 27 April 1905, ROM. He only saw a Broad-winged Hawk and two Chimney Swifts but it was the thrill of getting out of doors again that counted, a feeling of the promise of birds to come.
22. Taverner to Fleming, 30 November 1905, ROM.
23. E. Coues *Key to North American Birds* (Salem 1903) 5th edition.
24. J. A. Brashear to Taverner, 27 October 1904, ROM. Eventually Swales gave him a good pair.
25. Fleming to Taverner, 20 June 1909, ROM. Percy accepted them gratefully.
26. Taverner to Fleming, 18 August 1906, ROM.
27. W. E. Clyde Todd to Taverner, 8 August 1907, ROM.
28. Taverner Journal, 27 April 1905, ROM.
29. Taverner to Fleming 20 December 1911; 24 February 1912, ROM. His sister wrote after his death that "in Detroit his room was lined with bird cases which he made himself. He had quite a large collection ..." W. L. McAtee *The Auk* 65: 96 (1948).
30. Taverner to Fleming, 18 October 1905; 16 December 1905, ROM. The use of borax as a preservative came in later.
31. The layperson who is interested to know a little more about the collecting of birds, making of skins, sexing, labeling, and care of a collection will find a short outline of the subject in F. M. Chapman *Handbook of Birds of Eastern North America,* Second revised edition (1931) New York. Dover Publications reprint 1966.
32. J. H. Fleming "The Unusual Migration of Brunnich's Murre (*Uria lomvia*) in Eastern North America" *Proceedings of the Fourth International Ornithological Congress* pages 528-543 (1905).
33. Taverner "A Hyperlaken Migration Route" *Bulletin of the Michigan Ornithological Club* 6: 3-7 (1905). Most of Taverner's scanty records for Ontario came from the Toronto vicinity.
34. Fleming to Taverner, 3 December 1904, ROM. On Nelson's Sharp-tailed Sparrow see P. A. Taverner *Birds of Western Canada* National Museum of Canada, 1926, page 288.
35. Taverner to Fleming, 7 December 1904, ROM.
36. For a more detailed account of the GLOC see J. Cranmer-Byng "The Great Lakes Ornithological Club. The Origin and Early Years, 1905-1911" *Ontario Birds* 2: 4-12 (1984); J. Cranmer-Byng "The Bulletin of the Great Lakes Ornithological Club, 1905-1909" *Ontario Birds* 3: 45-54 (1985).
37. On the landscape see J. G. Battin and J. G. Nelson *Man's Impact on Point Pelee National Park* (National and Provincial Parks Association of Canada, Toronto 1978) chapters 1-2; 8, pages 90-92. On the Chestnut Oak see R. C. Hosie *Native Trees of Canada*, Canadian Forestry Service, Ottawa (1967) page 190.
38. A note by Saunders stated: "At Point Pelee Aug. '82 saw perhaps 50 all told in flocks of up to 10, rushing up and down through the woods. Shot only one which I have yet." Saunders Papers, December 1902, ROM. A fuller account given by Saunders is printed in Taverner and Swales "The Birds of Point Pelee" *The Wilson Bulletin* 19: 91 (1907).
39. Taverner Journal, 13 May 1905, ROM.
40. Same, page 109. Taverner wrote that they crossed to the east shore on this page but when he again wrote "east" shore on the next page he then crossed it out and wrote "west", which is correct.
41. Taverner Journal, 14 May 1905, pages 110, ROM.
42. Same, page 113.
43. Taverner smoked "T & B" tobacco. Saunders, a non-smoker, enlivened the monotony of the dreary march to Leamington from time to time by the remark, "Come now, let's have a smoke". P. A. Taverner "Will Saunders — Field Naturalist" in R. J. Rutter, editor, *W. E. Saunders Naturalist* (Toronto 1949) page 13.
44. Raymond Brothers, Awnings, Tents, Flags, Sail Covers, London, Ontario, to P. A. Taverner 25 August 1905, ROM.
45. Taverner Journal, 4 September 1905.
46. Taverner Journal, 5 September 1905, ROM. Ontario September 9th they found "quite a flock of Cardinals. Indeed this bird seems to be quite common and well established on the Point."
47. Taverner Journal, 6 September 1905, ROM.
48. Taverner Journal, 8 September 1905, ROM.
49. As quoted from Lynds Jones in P. A. Taverner and B. H. Swales "The Birds of Point Pelee" *The Wilson Bulletin* 19 38-39; 45-46; 48-49 (1907).
50. Letter Lynds Jones to the members of the Great Lakes Ornithological Club 16 December 1905, preserved in papers of the GLOC, ROM.
51. Taverner to Saunders, 27 September 1905. GLOC papers, ROM.
52. Taverner in "Notes and News" *The Auk* 21: 410 (1904).

53. Fleming Journal, 24 September 1905. ROM, Fleming Papers.
54. Taverner "Tagging Migrants" *The Auk* 23: 232 (1906).
55. Taverner Journal of Bird Observations (September 1904-July 1905) listed on last page of the book, ROM.
56. L. J. Cole "The Tagging of Wild Birds as a Means of Studying their Movements" *The Auk* 26: 143 (1909).
57. Same 137-143.
58. W. E. Saunders *The Auk* 27: 221-212 (1910). It was in 1915 that Miner began the bizarre practice of fixing biblical texts to the bands of geese.
59. Taverner to Fleming, 5 November 1905, ROM.
60. Although by early 1906 Taverner had read a number of sources on taxonomy and nomenclature, and had read Coues carefully, his knowledge of taxonomy was elementary. His arguments were developed from what Fleming told him in their discussions. Fleming could have presented a better case to Allen but was careful not to involve himself too deeply in the argument; he might need the support of Allen in the future on his own account.
61. Taverner to J. A. Allen, 30 March 1906, ROM.
62. J. A. Allen to Taverner, 13 June 1906, in reply to Taverner's letter of 10 June, ROM. The law of priority is that the first name properly published is the valid name for any taxonomic category such as family, genus, species. The starting point for the rule is 1 January 1758. Thus a zoologist may describe and name what he considers a "new species" only to find that it has been described and named in literature earlier. In that case the earlier name stands. A proposed statute of limitations would, if ever agreed on, limit the length of time that an original name in the literature would remain operative.
63. Indenture dated 21 May 1906. Registered at Bracebridge 25 May. Preserved in Land Registration Office, Bracebridge, Ontario.
64. Taverner Journal, 16-18 June 1906, ROM.
65. Signed copy of "Option to buy 55 Elmurst Avenue" dated 16 May 1906. ROM Taverner Papers (Sc 51 Box 3).
66. Fleming to Taverner, 13 September 1906, ROM. For statute of limitation see note 83.
67. Fleming to Taverner, 23 September 1906, ROM.
68. Taverner to Fleming, 27 September 1906, ROM.
69. These difficulties were forcefully explained by Macoun in a letter to C. H. Merriam, John Macoun to C. H. Merriam, 2 March 1906. Typed copy in Canadian Museum of Nature, Ornithology, Taverner Papers.
70. Albert Peter Low (1861-1942). Geologist with the Geological Survey of Canada. Commanded expedition to the Arctic 1903-1904. Director of Geological Survey 1906; Deputy Minister of Mines 1907. Retired 1913.
71. Fleming to Taverner, 6 October 1906, ROM.
72. Taverner to Fleming, 9 October 1906, ROM.
73. Fleming to Taverner, 14 October 1906. Fleming to Low, 13 and 17 October give more information on what had been in Fleming's mind. ROM Fleming Papers. A. P. Low to Fleming, 15 October 1906. Fleming to Taverner 16 October 1906 enclosing Low's letter. ROM Fleming Papers.
74. Taverner to Fleming, 31 October 1906. ROM GLOC Collection (xerox copy of original only).
75. Fleming's father had established a seed growing business on a three-acre plot at Yonge and Elm Streets, Toronto, in 1836. Fleming had experience in horticulture and this accounted for his interest in plants and his success in growing them in his own garden and green house. See L. L. Snyder "In Memoriam James Henry Fleming" *The Auk* 58: 2-3 (1941).
76. His office was in the Chamber of Commerce Building at the corner of State and Grisworld. There was a good view from there which Taverner made use of. In his Journal for 20 August 1906 he noted: "Today about 5 p.m. I was looking out of the window of our office in the Chamber of Commerce when I saw a flock of about fifteen Purple Martins passing to the southwest. They were flying straight along with the usual aerial evolutions and were evidently migrating.
77. See note 46.
78. It was found in the cedars on the west shore near the end of the Point on 21 May 1906. Fleming "Chuck-will's-widow and Mockingbird in Ontario" *The Auk* 23: 343-344 (1906). Taverner and Swales "The Birds of Point Pelee" *The Wilson Bulletin* 19: 135 (1907).
79. *The Wilson Bulletin* 20: 86 (1908).
80. *The Wilson Bulletin* 20: 107 (1908). A second [Northern] Mockingbird was taken in 1909 by Bert Gardner and sent to Saunders who reported the news to Taverner. Saunders considered that this second record from Point Pelee was significant, and that its status should be reconsidered.
81. *The Wilson Bulletin* 19: 151-153 (1907).
82. Saunders recorded one seen on 24 and 26 April 1909 in GLOC's "Birds Observed at Point Pelee" ms. record book Volume 1, 55, ROM. Two Bewick's Wrens were taken by Saunders at Pelee on 15 April 1917. W. E. Saunders "The Status of Bewick's Wren in Ontario" *Canadian Field-Naturalist* 33: 118 (1919).
83. Bert Gardiner (Anglicized Gardner) was of French Canadian descent. He knew Point Pelee intimately and had a good knowledge of its wildlife. Taverner obtained useful notes from him on breeding Wood Duck, and Snow Goose in November, as well as study specimens. In 1908 a hut with screened doors and windows was built to Taverner's design on his property. Taverner Journal 16 October 1908, ROM.
84. Taverner to Fleming, 22 March 1907, ROM.
85. Taverner to Fleming, 12 October 1907. As from 1983 the name Sparrow Hawk was changed to American Kestrel in the AOU Check-list.
86. Taverner to Fleming, 22 March 1907.
87. Swales to Fleming, 7 May 1907, ROM.
88. This permit is preserved in Taverner's papers at the ROM and is dated 9 March 1906.
89. Taverner to Fleming, 12 October 1907, ROM.
90. Saunders to Taverner, 8 November 1906, ROM. The birds were White-winged Crossbills.
91. Taverner Journal 23 March 1907, ROM. On 5 October he noted a covey of Bobwhites near his home in Highland Park.
92. Taverner Journal 21 November 1906.
93. Fleming to Taverner, 22 October 1907, ROM.

94. Taverner, Journal 25 May 1906, ROM. Woods claimed to have seen White-rumped Sandpipers without having written a description of the plumage. But when Taverner himself saw a White-rumped Sandpiper on the same mud flats a few days later he retracted his suspicions. Taverner Journal 2 June 1906.
95. Swales to Fleming, 18 November 1906, ROM.
96. Taverner Journal 11 August 1906, ROM.
97. Taverner to Fleming 22 March 1907, ROM.
98. Taverner Journal 5 May 1906, ROM.
99. Taverner Journal 2 June 1906.
100. P. A. Taverner "The Yellow-breasted Chat. A Character Sketch" *Bird Lore* 8: 132 (1906). Black-and-white drawing of bird in song-flight included. A colour wash drawing of a male Yellow-breasted Chat by Taverner was printed in Walter Barrows *Michigan Bird Life* Michigan Agricultural College Lansing (1912). (On Barrows see note 134.) The framed original is preserved in the Bird Range, Museum of Zoology, University of Michigan, Ann Arbor.
101. Fleming to Taverner 26 May 1903, ROM.
102. F. M. Chapman *The Warblers of North America.* Coloured illustrations by L. A. Fuertes and B. Horsefall, 3rd edition (New York 1907).
103. Note by William Brodie in GLOC Bulletin of 12 July 1906. ROM, GLOC Papers.
104. Taverner Journal 24 August 1907, ROM.
105. Swales manuscript "Bird Journal" Museum of Zoology, University of Michigan, Ann Arbor (extracts in ROM, GLOC Papers).
106. Taverner to Fleming 12 October 1907, ROM. Taverner was thinking of how much information on migrating birds could be gained if a bird banding station could be established at Point Pelee. It could be as valuable for information on migration as the German island of Heligoland in the North Sea where a successful banding station had recently been established. Taverner had the vision to realize what could be done if the finance was available. A few years later at Kingsville, near Leamington, Jack Miner owned the land and had the opportunity to start a successful bird banding station.
107. Taverner and Swales "Birds of Point Pelee" *Wilson Bulletin* 19: 38 (1907).
108. Same 48.
109. Taverner and Swales *Wilson Bulletin* 20: 93-94 (1908).
110. Same 79-82.
111. Fleming to Taverner, 2 January 1909, ROM.
112. Taverner to Fleming, 11 January 1909, ROM.
113. This is clearly illustrated by line drawings in W. E. Godfrey *The Birds of Canada* (Ottawa 1986) page 72-73.
114. On the status of the Trumpeter Swan in North America see W. E. Banko *The Trumpeter Swan* (Washington, 1960); F. C. Bellrose *Ducks Geese and Swans of North America* (Harrisburg, 1976); in eastern Canada H. G. Lumsden "Pre-settlement Breeding Distribution of Trumpeter, *Cygnus buccinator*, and Tundra Swans, *C. columbianus*, in Eastern Canada" *The Canadian Field-Naturalist* 98: 415-424 (1984).
115. J. H. Fleming "The destruction of Whistling Swans (*Olor columbianus*) at Niagara Falls" *The Auk* 25: 306-309 (1908); Fleming "The Niagara Swan Trap" *The Auk* 29: 445-448 (1912).
116. Taverner Journal 26 March 1908; Taverner "Notes on Swans" ROM.
117. Catalogue number 35001; gift of J. H. Fleming. The label on its leg shows that it was collected at Lake St. Clair 1873.
118. J. Grinnell "Better Vernacular Names" *The Condor* 8: 154 (1906). *The Condor* was a quarterly journal published by the Cooper Ornithological Society of California. Swales was a member of the club and knew Grinnell personally.
119. P. A. Taverner "The New Check-List" *The Condor* 9: 55-56 (1907).
120. W. Stone to Taverner, 12 April 1907, ROM.
121. Two folio books called "Birds Observed at Point Pelee". Volume 1 ran from May 1905–September 1912. Volume 2 began in 1913, ran until 1923 and then very spasmodically until the last entry of December 1927. ROM, GLOC Papers.
122. These "Notes and Clippings" are of some value historically for records of numbers of species such as Piping Plover, Volume 3, pages 278-283; Eastern Bluebird, Volume 8, pages 765-766, ROM.
123. Taverner Journal 31 May 1909, ROM.
124. Taverner to Fleming 16 June 1909, ROM.
125. Taverner Journal, 8 September 1905, ROM.
126. Henry J. Richmond "The birds' jumping-off place" *The Detroit News Tribune*, magazine section, 27 June 1909.
127. Arthur W. Andrews 1866-1950. Born Goderich, Ontario, lived in Detroit, Michigan from 1900 until his death. A fine furniture maker by profession, an entomologist by avocation. The Andrews collection of Michigan Coleoptera is preserved in the Museum of Zoology, University of Michigan. Obituary notice in *Annual Report* of the Museum of Zoology, University of Michigan, 1950.
128. Taverner to Fleming, 16 June 1909, ROM.
129. P. A. Taverner "Migrating Butterflies" *Entomological News* (1908) pages 218-220. Taverner described how they came to the extreme tip of the Point at the rate of about three a minute on fine days and launched directly out over the lake taking a line that would carry them directly across the open lake. "At times when there was a little wind their proceedings were a little different. As soon as they reached the end of the heavier timber they kept well down in the shelter of the dense red cedar and juniper growth as far as that went, and then crossed to the lee shore, and dropping down to near the water's edge, proceeded along in the cover of the sand dune until the first breath of wind was encountered when they gradually rose in the air and started over the lake on the usual course. The exactitude with which they followed each other was remarkable. One could stand between two red cedars where they crossed to the shore and ninety per cent of all butterflies would pass within striking distance of a net." An explanation of the why and how of the monarchs' migration is set out in a pamphlet published by Parks Canada, available at the Visitor Centre at Point Pelee National Park. Taverner met it as a problem to be mulled over; to us it is a phenomenon to be marvelled at.
130. Taverner to Fleming, 13 April 1909, ROM.
131. Taverner Journal, 14-16 October 1910, ROM.

132. P. A. Taverner and B. H. Swales "Notes on the Migration of the Saw-whet Owl" *The Auk* 28: 329-334 (1911).
133. Taverner to Fleming, 20 January 1910, ROM.
134. Walter B. Barrows *Michigan Bird Life*, Michigan Agricultural College Special Bulletin, 1912. Barrows was professor of zoology and physiology at the Agricultural College from 1894 until his death in 1923.
135. Taverner to Fleming, 20 January 1910, ROM.
136. Taverner to Fleming, 6 February 1910, ROM.
137. J. M. Macoun to Taverner, 2 February 1910, NAC, Geological Survey, Taverner Papers. R. G. 132, Volume 34, file 488.
138. Taverner to J. M. Macoun, 6 February 1910. NAC, Geological Survey, Taverner Papers. R.G. 132, Volume 34, file 488.
139. Taverner Journal 22 February 1909, ROM. Compare letter Taverner to Fleming, 27 February 1909, ROM. The episode was retold by Taverner in his contribution to the W. E. Saunders Memorial Night organized by the Brodie Club of Toronto, March 28 1944. Printed in R. J. Rutter, editor, *W. E. Saunders, Naturalist*, Federation of Ontario Naturalists, Toronto, 1949, page 17. Also in Taverner's "Geological Survey Museum Work at Point Pelee, Ont." *The Ottawa Naturalist* 28: 89-99 (1914).
140. Taverner to Swales, 22 February 1919, CMN.
141. Contains 33 typed pages. Present cover and handwritten title supplied by Archive staff, ROM.
142. Taverner to Fleming, 17 May 1910, ROM. A more detailed account of the expedition is contained in his Journal for 15 May 1910. On Arthur W. Andrews see note 127. Dr. William W. Newcomb was a Detroit attorney and amateur lepidopterist.
143. Taverner to Fleming, 16 June 1909, ROM.
144. Taverner Journal, 28 April 1907, ROM.
145. Taverner Journal, 17 May 1908.
146. Taverner to Fleming, 7 December 1904, ROM.
147. Taverner to Fleming, 7 February 1909, ROM.
148. Taverner to Fleming, 26 July 1907, ROM.
149. Taverner to Fleming, 20 January 1910.
150. Fleming to Taverner, 7 October 1910, ROM.
151. Taverner to Fleming, 22 October 1910, ROM.
152. Taverner to Fleming, 19 April 1908, ROM. It also showed that his hair was beginning to recede.
153. Taverner to Fleming, 31 October 1906, ROM.
154. Fleming to Taverner, 9 March 1907, ROM.
155. Taverner to Fleming, 22 March 1907, ROM.
156. T. S. Palmer to Taverner. Whereabouts of letter not known.
157. Taverner to T. S. Palmer. Also not known.

## Chapter 5

1. The Act of 1907 is reproduced in W. H. Collins "The National Museum of Canada" in *Annual Report for 1926*, pages 60-70. Canada Department of Mines; National Museum of Canada. Ottawa, King's Printer, 1928; and discussed in Zaslow, *Reading the Rocks, The Story of the Geological Survey of Canada 1842-1972*. Published by the Macmillan Co. of Canada Ltd. Toronto in association with the Department of Energy, Mines and Resources and Information Canada, Ottawa, pages 257-258.
2. Zaslow, page 259.
3. William Andrew Waiser, *The Field Naturalist: John Macoun, the Geological Survey and Natural Science*. Toronto University Press, 1989.
4. Waiser, *The Field Naturalist* 178-179. For a strongly critical view of the *Catalogue* see letter Harrison Lewis to Taverner, 15 November 1919 and Taverner's reply 19 November 1919, CMN.
5. Waiser, *Field Naturalist* 183.
6. Fleming to Taverner, 23 March 1910, ROM.
7. James Macoun to Fleming, 24 March 1910, ROM. The nephew was Stuart Logan Thompson 1885-1960.
8. James Macoun to Fleming, 24 March 1910, ROM.
9. Fleming to Taverner, 29 March 1910, ROM.
10. See Chapter 7, note 101.
11. Fleming to Taverner, 29 March 1910, ROM.
12. Taverner to Fleming, 30 March 1910, ROM. Taverner's letter to James Macoun of 6 February 1910 is in the Public Archives of Canada, Geological Survey, Taverner Papers, RG 132, Volume 34, file 488.
13. Fleming to James Macoun, 31 March 1910, ROM.
14. James Macoun to Fleming, 4 April 1910, ROM.
15. Taverner to Fleming, 30 March 1910, ROM.
16. W. E. Saunders to John Macoun, 14 April 1910 PAC, Geological Survey, R. G. 132, Volume 33, file 473.
17. James Macoun to W. E. Saunders, 18 April 1910 PAC, Geological Survey, R. G. 132, Volume 33, file 473. Saunders sent a copy to Fleming. ROM, Fleming Collection.
18. Fleming to Taverner, 6 April 1910, ROM.
19. Seton to Taverner, 15 November 1910, ROM.
20. Taverner to Fleming, 21 November 1910, ROM.
21. Taverner to Fleming, 21 November 1910, ROM.
22. R. W. Brock to Taverner, 25 November 1910, ROM. The idea of exhibiting birds and mammals in life-like positions in their natural habitats had recently taken root in some of the museums in the United States. Brock would have seen such displays in the summer of 1910 when he visited several museums in the United States to see for himself how to run a leading museum.
23. Taverner to Fleming, 28 November 1910, ROM.
24. Fleming to Taverner, 24 November 1910, ROM.
25. Fleming to Taverner, 30 November 1910, ROM.
26. Fleming to Taverner, night lettergram, 1 December 1910, ROM.
27. Fleming to Taverner, 2 December 1910, ROM.
28. Fleming to Taverner, 2 December 1910, ROM. Saunders' letter to Taverner on the subject was dated 30 November 1910.
29. Fleming to Taverner, 2 December 1910, ROM.
30. Taverner to Fleming, 7 December 1910, ROM. He also said he was sending to Brock proofs from the printing plates of the drawings for Barrow's forthcoming book, and some separates of his articles, adding "Perhaps it is best to strike while the iron is hot."
31. Fleming to Taverner, 2 December 1910, ROM.
32. Fleming to Taverner, 18 December 1910, ROM.
33. Fleming to R.W. Brock, 8 December 1910, CMN.
34. R. W. Brock to Taverner, 24 December 1910, ROM.
35. Fleming to Taverner, 28 December 1910, ROM.
36. R. W. Brock to Taverner, telegram 22 March 1911, ROM.
37. R. W. Brock to Taverner, letter 22 March 1911, ROM.

38. R. W. Brock to Taverner, 29 March 1911, ROM.
39. Fleming to Taverner, 3 April 1911, ROM.
40. Taverner, writing near the end of his life to a friend from his Ann Arbor days, described his heart trouble as "an old mitral murmur". Taverner to George Prey, 28 June 1946, CMN.
41. R. W. Brock to Taverner, 3 April 1911, ROM.
42. Taverner to James Macoun, 12 April 1911. James Macoun to Taverner, 18 April 1911, ROM.
43. Samuel Herring, taxidermist at the Biological Survey since 1884, retired 1912, died 1919.
44. Taverner to Fleming, 1 May 1911, ROM. His mother had been unwell and faced the possibility of having an operation. It is possible that by this time she had resigned from her job, and would not be earning. In his anxiety to leave her sufficient money until she and Ida could join him in Ottawa he had left himself too little, but was reluctant to ask her to send him money so soon.
45. Taverner to Fleming, 10 May 1911 (handwritten), ROM.
46. Taverner to Fleming, 13 May 1911 (handwritten), ROM.
47. Taverner to Fleming, 18 May 1911, ROM. This could have been true. There had been outbreaks of typhoid in past years, and fresh outbreaks occurred in subsequent years.
48. Taverner to Fleming, 4 June 1911, ROM.

## Chapter 6

1. The name of the museum was officially changed to the "National Museum of Canada" on 5th January, 1927. The name was officially changed again to the "Canadian Museum of Nature" on 1st July 1990.
2. One exception was the Redpath Museum in Montreal. Founded in 1882 in a beautiful building built as a gift to McGill University, it contained several collections including one of bird skins. Taverner first heard about the museum through Dr. Casey Wood. See Chapter 13 note 11 for more detail.
3. For the early development of bird banding in North America see F. C. Lincoln "Bird banding" in *Fifty Years' Progress of American Ornithology 1883-1933* (Lancaster, Pa. 1933) pages 65-87 (hereafter *Fifty Years' Progress*). Published by the American Ornithologists' Union and edited anonymously by F. M. Chapman and T. S. Palmer.
4. See chapter 4 , pages 30-31, note 63.
5. U.S. National Museum Bulletin, 2 volumes 1892-1995. Charles Emil Bendire was a retired army officer who had gathered much information on birds during his long military service in remote parts of the west. For development in the study of life histories see Herbert Friedmann "Advances in Life History Work" in *Fifty Years' Progress* (see note 3 above).
6. The snipe was printed in the *Osprey*; the owl in the *Auk*. On early bird photography Alfred O. Gross "History and Progress of Bird Photography in America" in *Fifty Years' Progress*. (See note 3)
7. For regions specified by Taverner as requiring studies of bird distribution see Taverner "Suggestions for Ornithological work in Canada" discussed in Chapter 7, pages 2-3, notes 2-13.
8. Author of *Extermination of the American Bison* (1887); *American Natural History* (1904) and other influential writings.
9. See also Janet Foster *Working for Wildlife: the Beginning of Preservation in Canada* (Toronto 1978) which gives information on the Canadian background to the decline in numbers of wildlife at this time.
10. See Chapter 4, note 34.
11. The first official bird sanctuary in North America was created in what was then the Northwest Territories (present day Saskatchewan) northwest of present day Regina. This was at Last Mountain Lake where some islands and shoreline at the north end of the lake were set apart as a breeding ground for waterfowl. After the passing of the Migratory Birds Convention Act in 1917 the reserve was officially named Last Mountain Lake Bird Sanctuary.
12. Taverner to Fleming, Wednesday ... (no date given) but Fleming's annotation on the letter shows that it was written in May 1911, ROM
13. Taverner to Fleming, 9 May 1911, ROM.
14. Taverner to Fleming, 10 May 1911, ROM.
15. Report Taverner to Brock, 12 May 1911, pages 1-2, CMN.
16. Taverner to Brock page 8.
17. Canada, *Sessional Paper 1911*, "Summary Report of the Geological Survey of Canada for 1910" [hereafter Summary Report].
18. Report Taverner to Brock, 12 May 1911 pages 2-3, CMN. Marianne G. Ainley in her study *From Natural History to Avian Biology: Canadian Ornithology 1860-1950* argues that Taverner made a decision in 1911 that he was to regret later. But neither Taverner nor Brock had the authority to make decisions about major questions of policy such as the scope of the ornithological collection. There was considerable infighting over funding while the museum was being organized and Brock had to be very careful what moves he made in relation to the Geological Survey. Members of parliament, who had the power of granting appropriations for the museum, had considerable appreciation of mining but the level of their appreciation of natural science was still unknown. (Unpublished Ph.D. thesis McGill University 1985) page 117.
19. Taverner to Brock, page 4. (See note 18)
20. Taverner to Brock, page 9. (See note 18) At the end of his report Taverner suggested that it would be well worth while to send him to see what was being done in other museums in order to avoid making mistakes. Brock himself had visited several museums in the United States the previous summer and supported Taverner's suggestion.
21. Fleming to Taverner, 6 June 1911, ROM.
22. Taverner to Fleming, 10 June 1911, ROM.
23. Taverner to Fleming, 10 June 1911, ROM. For more detail on the trip to Mer Bleue on 6 June see Taverner, in a typewritten note of 6 June 1911 in a file entitled "Notes on Plants, Animals, Insects etc. 1907-1911" (ROM Taverner Papers). Also note on another walk at same place 15 June 1911. Charles H. Young, an entomologist with the Experimental Farms Service, joined the Natural History Branch of the museum in 1907 and worked under the Macouns' supervision collecting and preparing invertebrate material.
24. Taverner to Fleming, 18 May 1911, ROM. George Rivers White (1856-1927) lived in Ottawa on the banks of the Rideau River from where he collected

many bird specimens and eggs. See In memoriam notice in *The Canadian Field Naturalist* 43: 103-104 (1929).

25. Taverner to Fleming, 13 May 1911, ROM.
26. Taverner to Fleming, 4 June 1911, ROM.
27. Taverner to Fleming, 19 June 1911, ROM.
28. Taverner to Fleming, 29 June 1911, ROM.
29. Taverner to Fleming, 29 June 1911, ROM. The Brooklyn Museum is part of Brooklyn Institute of Arts and Sciences, well known for its collections of Egyptian and oriental art. The Children's Museum (1899) contains a natural history collection.
30. Taverner to Fleming, 30 June 1911, ROM. Charles W. Richmond followed Ridgway as curator of birds at the U.S. National Museum and was responsible for the thorough card catalogue of names in the bird room.
31. Taverner to Fleming, 30 June 1911, ROM. Wells W. Cooke, member U.S. Department of Agriculture, Biological Survey, Washington from 1901. Amassed migration and distribution data with help of a network of observers. Taverner supplied him with information on water birds of the Great Lakes region from 1905.
32. Taverner to Fleming, 25 July 1911, ROM.
33. Report Taverner to Brock, 27 July 1911, page 1, CMN.
34. Taverner to Brock, page 4. (See note 33)
35. Taverner to Fleming, 16 August 1911, ROM. Frank C. Hennessey b. 1894. Accompanied Captain J. E. Bernier, Canadian navigator and explorer, on an exploration trip to the Arctic, as naturalist and artist. Wintered at Melville Island 1908-09. See Colin S. Macdonald, *compiler*, 1968 *A Dictionary of Canadian Artists* 2 volumes (Ottawa) pages 427-429. The arranging of bird specimens by years according to dates of arrival at the museum resulted in a Victoria Memorial Museum Register of Birds. Specimen number 1 was a Ruff taken at Toronto in May 1877 — it was listed as received in December 1911.
36. Canada *Sessional Papers* 1912 "Summary Report for 1911", page 374.
37. Taverner to Fleming, 16 August 1911, ROM.
38. After Taverner's retirement the distributional maps were not kept up by his successor A. L. Rand, but when Earl Godfrey followed Rand as zoologist in 1947 he brought the system up-to-date.
39. Fleming to Taverner, 21 August 1911, ROM.
40. Fleming to Taverner, 2 November 1911, ROM. James A. Munro. Born Manitoba 1884. As a boy collected birds eggs and made birds skins in the Toronto area. Spent much time with Dr. William Brodie, biologist at the Ontario Provincial Museum. Made a study of migration along the Toronto waterfront which was published in the *Ottawa Naturalist* in 1911. Moved to Okanagan Landing, B.C. in that year where he started collecting birds, eggs and mammals for sale commercially. In 1915 the British Columbia Provincial Museum hired him to collect for them in the Okanagan Valley. For his later career as Dominion Wildlife Officer see James L. Baillie "In Memoriam: James Alexander Munro" *The Auk* 86: 624-630 (1969).
41. Fleming to Taverner, 20 December 1911, ROM. Fleming wrote to Brock with the same suggestion. Fleming to Brock, 20 December 1911, CMN. The museum bought six Trumpeter Swans from Munro for $15.00.
42. Taverner to Fleming, 24 February 1912, ROM. On material collected earlier by G. M. Dawson and R. Bell and others see Chapter 14, note 4.
43. Taverner to Fleming, 6 March 1912, ROM.
44. Fleming to Taverner, 10 March 1912, ROM. Sheds light on Fleming's ideas and interests in zoology vis-a-vis the ROM.
45. Taverner to Fleming, 24 February 1912, ROM.
46. Taverner to Fleming, 24 February 1912, ROM.
47. Taverner to Brock, 2 February 1912, CMN.
48. Taverner to Brock, 13 February 1912, CMN.
49. Taverner to J. M. Macoun, 20 May 1912, CMN.
50. Taverner to J. M. Macoun, 30 July 1912, CMN.
51. Taverner to Brooks, 12 April 1912, CMN.
52. Taverner to Fleming, 6 March 1912. Also Taverner writing to Arthur Andrews, mentioned that members of the Geological Survey, "who have been all over the Dominion from the mouth of the Mackenzie to Nova Scotia, when they can be got to talk can tell enough experiences of pioneer life to make Jack London green with envy." Taverner to Andrews, 29 April 1912, CMN.
53. P. A. Taverner *Instructions Regarding the Collection of Zoological Specimens for the Victoria Memorial Museum* (Ottawa, Government Printing Bureau 1912).
54. Canada, *Sessional Papers* 1913, "Summary Report" for 1912, page 441.
55. Taverner to Swales, 26 December 1912, CMN.
56. Clyde Louis Patch (1887-1952). Grew up in Ohio and Michigan, apprenticed to a commercial taxidermist in Washington, D.C. Employed as taxidermist by the Biological Survey, U.S. Department of Agriculture, and by the American Museum of Natural History, New York. See obituary by Hoyes Lloyd "Clyde Louis Patch" *The Canadian Field Naturalist* 68: 124-126 (1954).
57. Taverner to Fleming, 5 December 1912, ROM.
58. Canada, *Sessional Papers* 1913, "Summary Report for 1912", page 443.
59. On what to read for an impression of Ottawa at this time: John H. Taylor *Ottawa: An Illustrated History* (Ottawa, 1986)
60. Taverner to Fleming, 10 May 1911, ROM. He confessed: "A week and a half of boarding house life is all I want and I want a home here as soon as I am permanently settled." Taverner's stammer was probably worse under the stress of his new job and new acquaintances. It would have been frustrating not to be able to speak fluently to his fellow lodgers and he would have felt at a disadvantage.
61. Taverner to Fleming, 4 June 1911, ROM.
62. Taverner to Fleming, 16 August 1911, ROM.
63. Fleming to Taverner, 21 August 1911, ROM.
64. Taverner to Fleming, 21 September 1911, ROM. Development had recently been started in an area bounded by the Rideau Canal to the north, the Rideau River to the south, Bank Street to the east and Bronson Avenue to the west. This area became known as Ottawa South, and the street where the Taverners built was named Leonard Avenue. The *Ottawa Street Directory* 1911 shows which houses were built and which lots were vacant at that time.

65. Taverner to Fleming, 17 October 1911, ROM.
66. Taverner to Fleming, 2 November 1911, ROM.
67. Taverner to Fleming, 3 April 1912, ROM.
68. Taverner to Arthur Andrews, 29 April 1912, CMN.
69. Taverner to Fleming, 6 August 1912, ROM. Outbreaks of typhoid occurred in Ottawa from time to time and a cholera epidemic occurred in 1917. The drinking water was the suspected source. Dr. Charles Camac of the College of Physicians and Surgeons, New York City, spoke to the Committee on Public Health of the Conservation Council on the subject of "The Epidemics of Typhoid Fever in the City of Ottawa" in 1912.
70. Taverner to Swales, 23 October 1912, CMN.
71. Taverner to Mrs Hinton, CMN.
72. Taverner to Fleming, 11 February 1913, ROM.
73. Taverner to Brock, 19 February 1913, CMN. She remained for thirty years.
74. Taverner to Brock, 19 February 1913, CMN.
75. Taverner to Brock, 20 January 1913, CMN.
76. Taverner to Brock, 6 February 1913, CMN. Not a sensible idea.
77. Taverner to James Harkin, 19 March 1913, CMN.
78. Taverner to Brock, 17 March 1913, CMN. The exchanging of specimens between one museum and another, or with a private collector, although a routine matter, is one that sometimes causes trouble. The decision as to what should be exchanged in return for what specimen(s) is a personal judgement, and may cause personal animosity between museum staff.
79. For example correspondence with Jim Macoun while Taverner was collecting at Point Pelee between 15 May and 18 July 1913. In one letter Jim Macoun asked Taverner to send him specimens of a rare species of violet from the Leamington area (15 May 1913). Taverner did send some and they were planted in the Experimental Farm. J. M. Macoun to Taverner, 26 May 1913. PAC RG 132 Volume 34 file 488, and CMN.
80. Zaslow *Reading the Rocks* pages 319-320. (See chapter 5 note 1.)
81. Taverner to Fleming, 27 February 1913, ROM. Taverner had not yet met Anderson and was not aware of what was happening at a higher level. Brock discussed with Taverner the idea of obtaining an appointment for Anderson at the museum on 28 February. Taverner's letter to Fleming is interesting in the light of later relations between the two men and the large part which Anderson was to play in Taverner's subsequent career. For Anderson's own career see Chapter 14.
82. When examining a problem concerned with a particular species an ornithologist is likely to require a series of plumages for comparison purposes. It is often possible to trace a gradual change in measurement and/or morphological characteristics as specimens are compared that have been taken from regions a considerable way apart. A change can be seen from smaller to larger, or darker to lighter. This is known as a cline. Populations of birds at either end of a cline may be strikingly different though they are linked by populations that grade imperceptibly one into the other. These populations are said to intergrade.
83. Canada, *Sessional Papers* 1914, "Summary Report 1913", 7-8; page 352 under additions to the zoological collection. A *type specimen* is a particular specimen of a bird, usually in the form of a museum skin, to which the scientific description of a species or subspecies refers. The "type specimen" is the skin for which the species or race was originally described. Such specimens are labelled with this information and can be re-examined in museum collections. This concept aims to preserve the stability of a taxon. Fleming was made an honorary curator of the National Museum of Natural Science in 1913.
84. Taverner to Fleming, 11 February 1913, ROM. Horace H. Mitchell, born England 1868. Came to Canada as a young man and worked in Oliver Spanner's taxidermy shop. Hired by the Saskatchewan Provincial Museum of Natural History at Regina in March 1913. A skilled craftsman who preferred exhibiting groups of birds in their natural habitat rather than single specimens. Mitchell held the post at the museum at Regina for twenty years, retiring in 1933. For further information see Annual Reports of the Game Commissioner, Department of Agriculture, Province of Saskatchewan.
85. Taverner to Fleming, 5 and 19 December 1912; 14 March 1913. Teslin Lake is situated on the Yukon-British Columbia boundary.
86. Taverner to Fleming, 19 December 1912. See P. A. Taverner *The Auk* 31: 385-388 (1914); also P. A. Taverner, Canada, Geological Survey, Museum Bulletin Number 7. December 1914, pages 1-4.
87. Fleming's Grouse was included in the fourth edition of the AOU *Check-list of North American Birds* 1931. It was also included in Taverner's *Birds of Canada* 1934 and subsequent editions. But it was omitted from the fifth edition of the *Check-list* 1957.
88. Taverner to Fleming, 27 February 1913, ROM.
89. Taverner to Fleming, 27 February 1913, ROM.
90. Taverner to Fleming, 11 May 1913, ROM. This was for Dr William H. Collins. Born 1878; appointed to the Geological Survey 1905; married in 1908. His house was on Rosedale Avenue close to Taverner's home. It was built to Taverner's design in 1913-1914. Personal communication from Mrs Ann Whitmore, daughter of W. H. Collins.
91. Taverner to Swales, 5 May 1913, CMN, "as busy as the devil ... "; Taverner to Fleming, same date "... like a chicken with its head off", ROM.
92. Taverner to Fleming, 16 January 1914, CMN. Dr Saunders was presumably W. E. Saunders' brother, Charles Saunders.
93. Taverner to Louis Bishop, 20 January 1914, CMN. Dr Louis B. Bishop M.D. of New Haven, Connecticut. Correspondence between Taverner and Bishop began in 1912 and continued regularly until 1940.
94. Taverner to Brock, 2 March 1914, CMN.
95. Brock to Taverner, 25 August 1914, CMN.
96. Memorandum to R. G. McConnell, Acting Deputy Minister of Mines, by the principal officers of the Geological Branch engaged in the work of the museum. Transmitted 16 October 1914.
97. Taverner to Fleming, 5 October 1914, ROM.
98. Claude E. Johnson. Mainly employed as colourist in the preparatory department, in the coloured illustrations of mammals and in painting background for habitat groups.
99. Fleming to Taverner, 13 February 1914, ROM. It was bought, along with various other specimens such as a female and a juvenile Spectacled Eider; Fleming to

Taverner, 10 April 1914. Taverner to Fleming, 17 April 1914 said: "The extralimital stuff is most desirable and just what we want.", ROM.

100. Fleming to Taverner, 29 June 1914; Taverner to Fleming, 19 September 1914, ROM.
101. Canada, *Sessional Papers* 1915, "Summary Report 1914", page 154.
102. Taverner to Fleming, 5 January 1914, ROM.
103. Taverner to Fleming, 17 April 1914, ROM.
104. Taverner to J. Leon Cole, 5 December 1914, in reply to letter from Leon Cole of 30 November 1914, from the College of Agriculture at the University of Wisconsin. Taverner's statement that he was head of a division is not accurate. The division was that of biology. Taverner was head of the sections of mammals and ornithology.

## Chapter 7

1. P. A. Taverner "Suggestions for Ornithological Work in Canada" *The Ottawa Naturalist* 29: 14-18; 21-28 (1915).
2. Same page 15
3. Same page 16
4. Same page 16-17
5. Same page 18
6. Same page 18
7. Same page 21
8. Same page 22
9. Same page 22
10. Same page 23
11. Same page 23
12. Same page 24
13. Same page 24-55
14. On the last great rookery near Petoskey, Michigan, see P. A. Taverner *Birds of Canada* (Ottawa 1934) page 253.
15. Taverner "Suggestions for Ornithological Work" page 27. (See note 1)
16. Taverner to Fleming, 12 April 1915; Fleming to Taverner, 14 April 1915. Royal Ontario Museum Archives, Percy A. Taverner Papers and J. H. Fleming Papers, hereafter ROM.
17. Taverner to Fleming, 10 August 1915, ROM.
18. Taverner to Fleming, 25 August 1915, ROM.
19. Fleming to Taverner, 30 August 1915, ROM.
20. Taverner to Fleming, 31 August 1915, ROM.
21. Taverner to Fleming, 25 August 1915, ROM.
22. Fleming to Taverner, 30 August 1915, ROM.
23. Fleming to Taverner, 18 November 1915, ROM.
24. Fleming to Taverner, 29 June 1915, ROM.
25. Taverner to Fleming, 14 July 1915, ROM.
26. For a biography of Brooks see Hamilton M. Laing *Allan Brooks: Artist Naturalist* British Columbia Provincial Museum, Victoria, 1979.
27. Taverner to Henry Mousley, 27 November 1914, Canadian Museum of Nature, P. A. Taverner Ornithology Archive, hereafter CMN. On Mousley see Marianne Ainley "Henry Mousley and the Ornithology of Hatley and Montreal, 1910-14" *Tchebec* 11: 113-134 (1981).
28. Taverner to Mousley, 22 February 1915, CMN.
29. Taverner to Fleming, 14 July 1915, ROM.
30. Fleming to Taverner, 22 November 1915, ROM.
31. Fleming to Taverner, 24 June 1915. Dr. W. A. Waiser, author of *The Field Naturalist. John Macoun, The Geological Survey, and Natural Science*, Toronto, 1989, commented as follows on this sentence in Fleming's letter: "Macoun did not like having younger people working under him because they were unreliable and liable to cause him trouble. His praise of Taverner was more of a compliment than it first appears to be." William Waiser, letter to author, June 1986.
32. John Macoun to Taverner, 7 March 1915, CMN.
33. W. A. Waiser, *Field Naturalist*, 197-198. (See note 31)
34. Taverner to L. Bishop, 5 July 1916, CMN.
35. Taverner to Fleming, 24 June 1916, ROM.
36. Taverner to Fleming, 19 July 1916, ROM.
37. Taverner to Fleming, 30 November 1916, ROM.
38. Taverner to Fleming, 7 June 1916, ROM.
39. Taverner to Fleming, 22 January 1916, ROM. For details of Patch's trip see Canada, *Sessional Paper* 1917, "Summary Report for 1916", page 353.
40. Taverner to Fleming, 5 October 1916, ROM.
41. Fleming to Taverner, 11 September 1916, ROM. Todd's book was finally published in 1963 by the University of Toronto Press under the title *Birds of the Labrador Peninsula and Adjacent Areas*.
42. Zaslow *Reading the Rocks* 324-325 (see chapter 5 note 1); Richard J. Diubaldo *Stefansson and the Canadian Arctic* (Montreal) 1978, pages 188-206.
43. Canada, *Sessional Paper* 1916, "Summary Report" for 1915, page 249.
44. Canada, *Sessional Paper* 1917, "Summary Report" for 1916, pages 9-11; 344-346.
45. Taverner to Swales, spring 1915, CMN.
46. Taverner to Fleming, 14 September 1915, ROM.
47. Taverner to Fleming, 12 May 1916, ROM; Taverner to Brooks, 15 May 1916, CMN.
48. Taverner to Fleming, 12 May 1916, ROM.
49. Taverner to Fleming, 25 May 1916, ROM.
50. Taverner to Fleming, 24 June 1916; Fleming to Taverner, 2 July 1916, ROM.
51. Taverner to Fleming, 7 June 1916, ROM.
52. Taverner to Fleming, 11 June 1916, ROM.
53. Taverner to Fleming, 29 November 1917, ROM. An X-ray showed abcesses at the roots of what seemed good teeth.
54. Taverner to Louis Bishop, 5 July 1916, CMN.
55. Taverner to Louis Bishop, 6 March 1917, CMN.
56. Taverner to Fleming, 6 February 1917, ROM.
57. Taverner to Fleming, 24 March 1917, ROM.
58. Anderson to Fleming, 30 June 1917, ROM.
59. Anderson to Fleming, 4 July 1917, ROM.
60. For a more detailed treatment of Anderson's background see Chapter 14.
61. Taverner to Fleming, 6 February 1917, ROM.
62. Taverner to Fleming, 26 February 1917, ROM.
63. Fleming to Taverner, 29 April 1917; Taverner to Fleming, 6 May 1917, ROM. Charles Lucien Bonaparte, a nephew of Napoleon I, tackled the description of the North American avifauna in his *American Ornithology* during an eight-year stay in America (1822-1828). He is generally acknowledged to have been a foremost ornithologist of his time. Bonaparte's Gull was named in his honour. For the contemporary status of *anthinus* see Godfrey, *Birds of Canada* 1986, page 524.
64. Taverner to Brooks, 14 August 1916, CMN.

65. Taverner to Fleming, 6 February 1917, ROM.
66. Taverner to Fleming, 29 September 1917, ROM. Percy sent a post card from Bala Falls to tell Fleming that he was spending the weekend at Muskoka, and that he expected to be returning mid-week and would stay a while in Toronto between trains. The only explanation I can think of for Percy's visit to Beaumaris was to ask the advice of one or two of his contacts there on building a cottage, perhaps to obtain some plans and measurements.
67. Taverner to Fleming, 12 January 1918; 30 January 1919, ROM.
68. Taverner to Fleming, 5 April 1917, ROM.
69. J. M. Macoun to R. G. McConnell, 22 February 1918, NAC. I am grateful to Professor W. A. Waiser for sending me this quotation.
70. Waiser *Field Naturalist*, pages 198-199. (See note 31)
71. Waiser *Field Naturalist*, page 199. (See note 31)
72. Taverner to Fleming, 18 September 1918, ROM.
73. Taverner to Fleming, 21 July 1919, ROM.
74. Taverner to J. M. Macoun, 15 July 1919, CMN.
75. Taverner to Fleming, 31 December 1918, ROM.
76. Taverner to Fleming, 27 February 1918; same to same, 11 December 1918; Fleming to Taverner, 16 December 1918, ROM.
77. Taverner to Brooks, 24 October 1918, CMN.
78. Taverner to Fleming, 26 February 1918, ROM. A King Log is a *roi faineant*, a king who rules in peace, but never makes his power felt. An allusion to the Greek myth of the frogs who asked Jupiter for a king. At first Jupiter threw down a log to govern them, but they complained at so spineless a king. In response Jupiter sent them a stork, who ate them all up with gusto. Luckily for Taverner and his colleagues they never had to live under a King Stork.
79. James Harkin b. 1875 Ontario. Parliamentary correspondent with Montreal and Toronto newspapers. Private Secretary to Clifford Sifton, Minister of Interior in Laurier's government. Dominion Parks Commissioner 1911. Gordon Hewitt b. 1885 England. B.Sc. in zoology Manchester University, Ph.D. 1909; lecturer in Economic Zoology; Dominion Entomologist Canadian Dept. of Agriculture 1909. Robie W. Tufts "Notes on the birds of the Grand Pre region, King's County, Nova Scotia" *Transactions of the Nova Scotian Institute of Science* 14: 154-199 (1917).
80. Taverner to Robie Tufts, 28 February 1918, CMN. Tufts was born 1884 Wolfville, Nova Scotia. Educated Acadia University. Keenly interested in field observations of birds.
81. Taverner to Fleming, 24 March 1916, ROM. It is of interest to note that sixty-one years later when the *Breeding Bird Atlas of Ontario* was published, although more than 70 000 Black Scoters were seen summering off the northern coast (Hudson Bay region) of Ontario not a single confirmed breeding record existed for Ontario.
82. Taverner to Fred Bradshaw, 24 October 1919, CMN. The list by Fleming referred to by Bradshaw is: J. H. Fleming "Birds of northern Saskatchewan and northern Manitoba collected in 1914 by Capt. Angus Buchanan", *The Canadian Field-Naturalist* 33: 109-113 (1919).
83. Bradshaw to Taverner, 28 October 1919, CMN.
84. Taverner to Bradshaw, 6 November 1919, CMN.
85. W. J. Brown to Taverner, 29 January 1919, CMN. P. A. Taverner "The Birds of the Red River, Alberta" *The Auk* 36: 1-21; 248-65 (1919). In his reply of 5 February 1919 Taverner explained to Brown that in the more southern localities of Canada changes in the countryside were proceeding very rapidly and he therefore wanted to record the birds before they vanished for ever.
86. Taverner to W. J. Brown, 5 February 1919, CMN.
87. Brown to Taverner, 11 February 1919, CMN.
88. Taverner to Brown, 15 February 1919, CMN.
89. Taverner to Brown, 25 February 1919, CMN. Taverner did considerable taxonomic research on the Great Horned Owl. For comparison see P. A. Taverner *Birds of Eastern Canada* (1919) and Taverner *Birds of Canada* (1934) under Great Horned Owl. Also Chapter 16, pages 411-412 and note 105.
90. Taverner to Brown, 25 February 1919, CMN.
91. For instance Taverner to Fleming, 12 March 1918, in which he wrote that Mousley was giving the museum a lot of fine warbler nests *in situ*, and good for exhibition groups.
92. Fleming to Taverner, 1 October 1918, ROM. Writing to Taverner on 2 December 1918, soon after Lloyd had been appointed, Fleming said that he had an analytical mind that would be of great service in ornithology, and that Lloyd was in the forefront of young chemists.
93. Fleming to Taverner, 13 October 1918, ROM. Lloyd collected bird skins in the 1900s and published his first ornithological paper in 1917. H. Lloyd "Ontario Bird Notes" *The Auk* 34: 457-460 (1917). Also in conjunction with J. H. Fleming he wrote "Ontario Bird Notes" *The Auk* 37: 429-439 (1920). Articles by Lloyd on "Birds of Ottawa" began appearing in *The Canadian Field-Naturalist* in September 1923.
94. Fleming to Taverner, 29 November 1918, ROM.
95. Taverner to Fleming, 27 December 1918, ROM.
96. Taverner to Fleming, 14 January 1919, ROM.
97. Fleming to Taverner, 16 January 1919, ROM. The BOU honoured several North American ornithologists at its annual meeting in 1919 including D. L. Stejneger who became an honorary member, and Dr. Joseph Grinnell and Outram Bangs became foreign members. *The Ibis*, Journal of the British Ornithologists' Union. Founded in 1859. Still one of the most prestigious English language ornithological journals. Named after the *Ibis* family of birds.
98. Taverner to Fleming, 25 February 1919; Fleming to Taverner, 24 March 1919, ROM, reported that Mitchell had recently been to see him. Fleming told him that he hoped Patch would tell him everything possible when in Ottawa.
99. Taverner to J. M. Macoun, 6 September 1919, CMN.
100. Taverner to Fleming, 10 October 1918, ROM.
101. Taverner to Fleming, 8 October 1919, ROM.
102. Taverner to Fleming, 21 July 1919, ROM.
103. Taverner to J. M. Macoun, 6 August 1919, CMN.
104. Taverner to Fleming, 17 September 1919, ROM.
105. Entry in log book of Hyla cottage 28 September 1919. I am grateful to Mr. Corwin Ferguson of Detroit for lending me the Hyla log book to take notes from.

106. Anderson to Fleming, 11 October 1919. ROM Fleming Papers.
107. Anderson to Fleming, 27 October 1919, ROM. Owners of lots on Big Island were nearly all museum people.
108. Waiser *The Field Naturalist* pages 199-200. (See note 31)

## Chapter 8

1. Taverner to Swales, 26 December 1912, ROM; P. A. Taverner "Geological Survey Museum Work on Point Pelee, Ont." *The Ottawa Naturalist* 28: 97-106 (1914).
2. Taverner "Journal" 28-30 May 1910, pages 330-331, ROM.
3. Taverner to Swales, 23 October 1912; Taverner to Brooks, 8 December 1912, CMN.
4. Taverner to Fleming, 5 May 1913; 11 May 1913, ROM. There were rules for which department should buy what commodities, and how to order them.
5. Entitled "Birds observed at Point Pelee. The Property of Camp Coues". It was volume 2, and began in 1913, ROM.
6. This specimen is preserved in the National Museum #6797. It is an immature male molting into summer plumage.
7. J. G. Battin and J. G. Nelson *Man's impact on Point Pelee National Park* (Toronto, 1978) pages 89-90.
8. Taverner to Swales, 6 June 1913, CMN.
9. Taverner to James Macoun, 19 June 1913, CMN. He also wanted advice on how to use a tree such as the redbud which was not yet in flower.
10. Taverner to Fleming, 20 June 1913, ROM.
11. Taverner to Fleming, 5 August 1913, ROM. In the same letter he said that the exhibit "was a frost. Hardly a soul looked at it".
12. Taverner to Fleming, ROM.
13. Saunders to Swales, 29 June 1913, CMN.
14. Collection of 13 black-and-white photos approximately 3 × 5 inches with brief captions. Some were sent by Taverner to friends as Christmas greetings December 1913. ROM archival material. Some of Taverner's Point Pelee negatives of 1913 are preserved in the Canadian Museum of Nature photographic collection.
15. P.A. Taverner *The Ottawa Naturalist* 28: 98 (1914).
16. Saunders to Swales, 29 June 1913, CMN.
17. Taverner to Swales, 26 December 1912, CMN.
18. Taverner to Fleming, 14 March 1914, ROM.
19. Taverner to Brooks, 18 March 1914, CMN.
20. Taverner to Fleming, 17 April 1914, ROM.
21. Canada, Sessional Paper 1915, "Summary Report for 1914", pages 158-159.
22. Typed copies in ROM Archives, Percy Taverner Papers.
23. Taverner to Mrs. Ida Taverner, dated Bathurst 14 June 1914, ROM. This date is probably wrong. Percy explained that from Miscou to Percé by sailboat could take as little as four hours, but all the boats were busy fishing at that time and no reliable arrangement could be made. The rail journey round Chaleur Bay was several hundreds of miles.
24. Taverner to Ida Taverner, 21 June 1914, ROM. The same view, on a sunny summer's day, can have the same effect on the visitor to Percé now as it did on Taverner then.
25. Taverner to Ida Taverner, 21 June 1914, ROM.
26. Taverner to Ida Taverner, 6 July 1914, ROM. There is nothing fanciful about this description. To the present day visitor the masses of wheeling birds above the cliff on Bonaventure Island can be equally as inspiring.
27. Taverner to Ida Taverner, 18 July 1914, ROM.
28. Taverner to Ida Taverner, 30 July 1914, ROM.
29. Taverner to Ida Taverner, 30 July 1914, ROM. Percy explained that just at this period, and the next few weeks, the cormorants would be coming into a particular plumage phase. Such birds were needed to complete the museum's series of plumages.
30. Taverner to Ida Taverner, 8 August 1914, ROM. The Bird Rocks (Les Rochers des Oiseaux) lie about twenty miles north of the Magdelens. The larger one is a red sandstone hillock, with a lighthouse on it, and a population of around 12 000 birds in total in 1914-1915. A smaller bird rock nearby is lower and less dramatic but also supported a large number of nesting seabirds. J. J. Audubon passed great Bird Rock on 14 June 1833 on his visit to Labrador, and described what he saw in his Journal of that date. Harrison F. Lewis "Some Canadian Audubonianа" *The Canadian Field-Naturalist* 47: 162-172 (1933).
31. Taverner to Ida Taverner, 12 August 1914, ROM.
32. Taverner to Ida Taverner, 12 August 1914, ROM. This part of the letter was written a few days later but included under this date.
33. Taverner to Ida Taverner, 12 August 1914, ROM, later section.
34. Taverner to Ida Taverner, 12 August 1914, ROM, later section.
35. Taverner to Ida Taverner, 8 August 1914, ROM.
36. Canada, Geological Survey Museum Bulletin 13, 1915.
37. Taverner to mother and sister, 8 August 1914, ROM.
38. A. C. Bent to Taverner, 2 December 1914; Taverner to Bent, 5 December 1914, CMN. From the beginning of the correspondence between Taverner and Arthur Cleveland Bent the subjects they discussed were interesting and the information they gave was detailed. These letters on plumage change in gannets was no exception.
39. Canada, Sessional Papers 1916, "Summary Report for 1915", pages 260-262.
40. Taverner to mother and sister, 11 June 1915, ROM.
41. Taverner to Fleming, 12 June 1915, ROM.
42. Taverner to mother and sister, 11 June 1915, ROM.
43. Taverner to Fleming, 4 July 1915, ROM. He described the landscape with the eye of an artist but economically. "The moss in fact tends to cover every stone & bare place growing [word illegible] and in all colors of gray through green and brown to dull red. The color of the landscape at first glance is dull sage green but close observation shows wonderful color everywhere — gray, green, red and violet on every hand and a [two words illeg.] makes a kaleidoscopic effect I have seldom seen equaled".
44. See note 39 above.
45. Frank Chapman *Camps and Cruises of an Ornithologist* (New York 1908) pages 315-336.
46. Taverner to Fleming, 26 July 1917, ROM; P. A. Taverner "The Birds of Shoal Lake, Manitoba" *The Ottawa Naturalist* 32: 137-144; 157-164 (1919); 33:

12-20 (1919). This is an annotated list of the birds of that locality from observations and collections made in 1917 and 1918 which Taverner considered to be a fairly complete and representative list. No letters from Percy to his family appear to have survived for 1917. But see Taverner to L. Bishop, 12 October 1917, CMN.

47. P. A. Taverner "The Birds of the Red Deer River, Alberta" *The Auk* 36: 1-21; 248-265, 1 map (1919); Taverner to Fleming, 26 July 1917, ROM.
48. Taverner to W. E. Saunders, 11 October 1917, CMN. For a short note on the Whyte Museum see *Official Directory of Canadian Museums and Related Institutions*. Canadian Museums Association (yearly).
49. Taverner to Munro, 9 October 1917, CMN. In this newsy letter Taverner told Munro that he was home again after five months in the field, and described his itinerary after leaving him in July. His letter contained one cryptic reference when he wrote: "Do not let my unfortunate appearance at Okanagan Landing disturb you. It was one of those unavoidable accidents. I am delighted to hear that Mrs. Munro recovered." His "unfortunate appearance" was probably due to the use of arsenic while preparing bird skins in the field. From Munro's reply of 3 November 1917 it is clear that Isabella Munro was critically ill. She died in 1919.
50. Taverner to Fleming, 20 August 1917 (from Prince Rupert), ROM. Informing him of the birds he has been seeing. Also contains a brief reference to "Munro's tragedy". Taverner had stayed four days at Alert Bay, Cormorant Island, off Vancouver Island. Apart from birds, the village had a major collection of totem poles. He obtained a lot of good plumages and made colored drawings of bills and feet while there.
51. P. A. Taverner "The Summer Birds of Hazelton, B.C." *Condor* 21: 80-86 (1919).
52. P. A. Taverner "William Spreadborough — Collector 1856-1931", *Canadian Field-Naturalist* 47: 39-41 (1933) .
53. P. A. Taverner, see note 52, pages 39-41.
54. P. A. Taverner, see note 52, pages 41-42. Brooks, writing to Taverner on 25 September 1919, mentioned that Spreadborough did not identify Brewer's Sparrow. Taverner replied: "I am not surprised that Spreadborough misses Brewer's Sparrow. You know that he is only a shanty man". It was surprising, Taverner explained, that with only guidance from the Macouns Spreadborough managed as well as he did. He had no one to guide him in the finer points and only collected the obvious. Certainly he got few rare species, Taverner said, "but if it had not been for him we would not have much of a collection now and our knowledge of Canadian birds would be smaller than it is even allowing for the inaccuracies that have crept in through some of his statements." Taverner to Brooks, 6 October 1919, CMN.
55. P. A. Taverner "Birds of Shoal Lake" page 140. (See note 46)
56. Taverner to Fleming, 25 July 1918, CMN.
57. Taverner to Brooks, 7 October 1918, CMN. Also Taverner to L. Bishop, 30 July 1918, CMN; Taverner to Fleming, 18 September 1918, ROM. For information on his field notebooks see note 60 below.
58. Taverner to Fleming, 21 May 1919, ROM. What Taverner meant by "waiting for the word to go or stay" was waiting for Parliament to grant appropriations to the museum for field expeditions.
59. Taverner to Fleming, 21 July 1919, ROM.
60. For details of contents of all Taverner's field notes from 1913 to 1937, both the handwritten and the later typewritten ones, see the *Catalogue "Field notes in ornithology collections"* compiled by Michel Gosselin 1992, CMN.
61. Taverner to Fleming, 14 March 1914; Fleming to Taverner, 19 March 1914, ROM.
62. An account of the expedition was given by Charles Camsell in chapter 31, "Taltson River Exploration" in his autobiography *Son of the North* (1954).
63. Francis Harper, Canada: Sessional Papers 1915 "Summary Report for 1914", 159-163. Harper later published accounts of results in 1931. "Physiographic and faunal areas in the Athabasca and Great Slave Lakes region". Ecology 12: 18-32 (1931). "Amphibians and reptiles of the Athabasca and Great Slave Lakes region." *The Canadian Field-Naturalist* 45: 68-70.
64. Taverner gave the name American Mew Gull as an alternative name for the Short-billed Gull in his *Birds of Western Canada* pages 57-58 (1926).
65. Taverner described this goose in *Birds of Western Canada* as *Branta canadensis hutchinsi*, a subspecies in between the large Honker (*B. c. canadensis*) and the small Cackling Goose (*B. c. minima*). Normally the Hutchin's Goose was found breeding on the Barren Grounds and the Arctic Islands, a long way north of the Taltson River.
66. See under "Accessions" in the "Summary Report for 1914", page 155.

## Chapter 9

1. T. Gilbert Pearson "Fifty Years of Bird Protection in the United States" in Frank Chapman and T.S. Palmer, editors, *Fifty Years' Progress of American Ornithology 1883-1933* American Ornithologists' Union (Lancaster, Pennsylvania, 1933) pages 199-200.
2. Pearson "Fifty Years" pages 201-202. (See note 1)
3. Pearson pages 208-210. (See note 1)
4. These bird observations were arranged according to the AOU Check-list (1931) and written up with notes based on Fothergill's manuscripts by R. Delamere Black "Charles Fothergill's Notes on the Natural History of Eastern Canada, 1816-1837" *Transactions of the Royal Canadian Institute* 20: 141-168 (1934). Fothergill's ms. notes are preserved in the Fisher Rare Book Library, University of Toronto (MS 140 v 22).
5. See Hugh R. MacCrimmon *Animals, Man and Change: Alien and Extinct Wildlife in Ontario* (Toronto 1977) pages 27-28. Also M. D. Cadman et al., editors, *Atlas of the Breeding Birds of Ontario* (Waterloo, 1987) page 142.
6. Margaret H. Mitchell *The Passenger Pigeon in Ontario* (Toronto, 1935) pages 129-139.
7. Janet Foster *Working for Wildlife: the Beginnings of Preservation in Canada* (Toronto, 1978) page 10.
8. J. Foster *Working for Wildlife* page 26. (See note 7)
9. Foster *Working for Wildlife* page 13 (See note 7)

10. Foster (see note 7) pages 38-40; For a valuable account of the Commission of Conservation see Michel F. Girad "The Commission of Conservation as a Forerunner to the National Research Council 1909-1921". *Scientia Canadensis* 15, Number 2, 1991 (published by Canadian Science and Technology Historical Association) pages 19-40.
11. Foster (see note 7) pages 77-78.
12. Quoted in Foster (see note 7) 127-128.
13. Foster (see note 7) pages 128-129. The material which follows in the next pages is discussed more fully in Foster 128-138.
14. Maxwell Graham to James Macoun, 20 March 1913, Canadian Wildlife Service Records Migratory Bird Protection.
15. Taverner to Graham, 22 March 1913, CMN.
16. Foster *Working for Wildlife* 130. (See note 7)
17. C. Gordon Hewitt born in England 1885. Studied Manchester University. Doctor of Science. Appointed Dominion Entomologist, Canada, 1909. For his role in the protection of wildlife in Canada see Janet Foster *Working for Wildlife* pages 136-138 and index. Obituary in *The Canadian Entomologist* 52: 96-97 (1920).
18. On James White see Michel Girard "Commission of Conservation" (see note 10) pages 23-39. As Chief Geographer of the Dominion, White had the first *Atlas of Canada* published.
19. "Supplement to an Address on Animal Sanctuaries in Labrador by Lt. Colonel William Wood, F.R.S.C." Published by the author in pamphlet form 1912. See Foster *Working for Wildlife* 180-185. (See note 7)
20. Foster *Working for Wildlife* 182-183. (See note 7)
21. Taverner's findings were published in "The Double-crested Cormorant (*Phalacrocorax auritus*) and its Relation to the Salmon Industries on the Gulf of St. Lawrence". Geological Survey Canada. Museum Bulletin 13: 1-16 (1915).
22. Taverner to Harkin, 14 December 1914. Harkin to Taverner, 21 January 1915, CMN. From this time onwards Harkin consulted Taverner fairly often.
23. The memorandum contained photographs of the gannet ledges on Bonaventure Island taken by Taverner. Taverner did not speak at the meeting in January perhaps because of his stammer, or because he was not sufficiently senior to be asked.
24. Taverner to Fleming, 10 February 1915, enclosing a copy of his memorandum to Harkin, ROM.
25. Taverner to Fleming, undated, but see on same subject Taverner to Swales, 3 November 1915, CMN. Saunders' talk, "Bird Protection in Canada", was given before the "Committee on Conservation of Fish, Birds and Game of the Commission of Conservation". It was published in the *Report of the Commission of Conservation* (1916) pages 117-119.
26. Charles Townsend "Preliminary Report of an Expedition along the North Shore of the Gulf of St. Lawrence" in Canada, Sessional Papers 1916, "Summary Report for 1915", pages 262-263.
27. Taverner, Summary Report (1915) pages 261-262.
28. Taverner to White, 3 September 1915, CMN.
29. See James M. Linton and Calvin W. Moore *The Story of Wild Goose Jack: the Life and Work of Jack Miner*, Toronto 1984. Also Janet Foster *Working for Wildlife* (see note 7), mentions Miner's achievements in relation to the contributions of others to bird conservation.
30. There is a trail which may lead to proving this to be more than a supposition. But I need time to research the ramifications of the relations between W.E. Saunders — P.A. Taverner, and Saunders — J. Miner in the years 1905-1906.
31. See Taverner "Memoirs of William Edward Saunders 1861-1943" *The Auk* 61: 350 (1944).
32. W.E. Saunders and J.A. Morden *Canadian Sportsman and Naturalist* 2: 183-187; 192-194 (1882). Also with Morden "The Ornithology of Western Ontario" *Canadian Sportsman and Naturalist* 3: 243 (1883). For Morden's obituary notice see William E. Saunders "John A. Morden 1859-1919" *Canadian Field-Naturalist* 51: 108 (1937).
33. Manley Miner to P. A. Taverner, 6 March 1946, CMN. For information on W. E. Saunders as a naturalist in southwestern Ontario see William W. Judd *Early Naturalists and Natural History Societies of London, Ontario* (London Ontario 1979) pages 57-96.
34. James M. Linton and Calvin W. Moore *The Story of Wild Goose Jack; the Life and Work of Jack Miner* (Toronto 1984).
35. Taverner to White, 28 March 1916. Correspondence between Taverner and White is preserved in CMN, P. A. Taverner Ornithology Archives under "Commission of Conservation".
36. Taverner to Townsend, 28 March 1916, CMN; also letter 31 March 1916 in which Taverner stated "The worst of it is those people get things done, and one cannot ignore them without losing important assistance in good work. It is annoying, however, to find that one has to tie them up like sharpers before trusting them with anything". Taverner implied that the Commission were apt to use other people's photographs and writings without acknowledgement.
37. This paragraph is based on Janet Foster's account in her book *Working for Wildlife* (see note 7) pages 127-144. The text of the Convention is printed on pages 225-235. The Act was to be cited as *The Migratory Birds Convention Act*.
38. Foster *Working for Wildlife* 144-146. (See note 7)
39. Taverner to Swales, 3 November 1915, CMN.
40. Taverner to John H. Sage, 23 October 1916, CMN. Taverner had received some praise from Hewitt in 1915 who said "In the matter of education very satisfactory work has been carried on through the efforts of the Departments of Agriculture and Mines, through Mr. Taverner in the Geological Survey ... " C. Gordon Hewitt "Conservation of Birds and Mammals in Canada" in proceedings of a meeting of the Committee on Fishes, Game and Fur-bearing Animals November 1 and 2 1915, pages 144-145. This was not much praise but it was some slight recognition.
41. Taverner to Fleming, 30 January 1918, ROM.
42. Foster *Working for Wildlife* 161-163. (See note 7)
43. Foster (see note 7) 169-172 on information from Anderson.
44. Taverner to Hewitt, 27 December 1917, CMN.
45. Taverner to Hewitt, 18 January 1918.
46. Taverner to Fleming, 16 February 1918, ROM.
47. Brooks to Taverner, 10 September 1918; Taverner to Brooks 7 October 1918, CMN.

48. Taverner to Swales, 28 December 1918, CMN.
49. Foster *Working for Wildlife* page 159. (See note 7) Information based on an interview (1971) which Foster had with Harrison F. Lewis who was appointed Federal Migratory Bird Officer for Ontario and Quebec in 1920.
50. Taverner to Bishop, 16 January 1919, CMN.
51. Foster *Working for Wildlife* 179-180. (See note 7)
52. See note 23 above.
53. Foster *Working for Wildlife* (see note 7) pages 125; 194-197; also the monthly magazine *Rod and Gun in Canada* (1917).
54. Hewitt to Taverner, 9 May 1918, CMN.
55. Hewitt to Taverner, 13 December 1918; 18 December 1918, CMN.
56. Hewitt to Taverner, 31 January; 27 February; 11 March 1918; 4 February 1919, CMN.
57. Hewitt died of pleural pneumonia on 29 February 1920. See Foster *Working for Wildlife* 209-210. (See note 7) Obituary by Norman Criddle in *The Canadian Field-Naturalist* 34: 174-176 (1920).
58. On this subject see NAC Records. Point Pelee National Park January-June 1919.
59. Edward R. Kerr to W. E. Saunders, 8 May 1919, CMN.
60. E. R. Kerr to W. E. Saunders, 16 May 1919.
61. Duck hunting was ended at Point Pelee National Park by order of the Federal Environment Minister, Lucien Bouchard, on 6 June 1989. The press release issued by the Minister (reference PR-HQ-089-24) also contained a one page background on "Duck hunting at Point Pelee National Park".
62. P. A. Taverner "The Gannets of Bonaventure Island" *Ottawa Naturalist* 32: 21-26 (1918).
63. Taverner to Hewitt, 13 December 1918. Taverner's expectation, that if the birds of Bonaventure and the town of Percé were protected, the townspeople would benefit considerably by the tourist trade, was confirmed later by a letter to Taverner from a local resident.
64. Hoyes Lloyd "The Ornithological Collector and the Law" *The Canadian Field-Naturalist* 33: 93-94 (1919); "Permits to Collect Birds for Scientific Purposes in Canada" *The Auk* 36: 621-623 (1919); P. A. Taverner *Vanished and Vanishing Birds* Dominion Parks Branch Migratory Bird Leaflet (1919). Also in French edition.
65. Taverner *Vanishing Birds* 3. (See note 65)
66. Taverner *Vanishing Birds* 4. (See note 65)
67. Taverner *Vanishing Birds* 8. (See note 65)
68. Taverner to J. Miner, 14 November 1918, CMN.
69. J. Miner to Taverner, 4 December 1918, CMN.
70. Taverner to J. Miner, 12 December 1918, CMN.
71. C. Gordon Hewitt "The Need of Nation-wide Effort in Wild Life Conservation" *National Conference on Conservation of Game, Fur-bearing Animals and other Wild Life*. Under the Direction of the Commission for Conservation in co-operation with the Advisory Board on Wild Life Protection, February 18 and 19, 1919 (Ottawa 1919).
72. Edith L. Marsh, local historian and naturalist, died Peasemarsh Farm, Thornbury, Ontario 10 July 1960. Author of *Where the buffalo roamed* (Toronto, 1908); *Birds of Peasemarsh* (Toronto, 1919); *With the birds* (Toronto, 1935).
73. Jack Miner "Attracting Wild Fowl" in *National Conference on Conservation of Game ...* (Ottawa, 1919) pages 82-89. (See note 72)
74. Taverner to Swales, 22 February 1919, CMN. The phrase "a scrap of paper" was used by the German Chancellor, Theobald Von Hollweg, at the outbreak of war between Great Britain and Germany on 4 August 1914. When interviewing the British Ambassador in Berlin he said "Just for a word — 'neutrality', a word which in wartime has so often been disregarded, — just for a scrap of paper Great Britain is going to make war." Taverner knew the significance of this phrase to the public at that time.
75. Taverner to Swales pages 3-4. About Jack Miner see note 73.
76. Taverner to Fleming, 25 February 1919, ROM.
77. Miner to Taverner, 21 February 1919, CMN.
78. Taverner to Miner, 25 February 1919, CMN.
79. In the early 1930s, when the future wildlife artist Terry Shortt had recently joined the Royal Ontario Museum, he was given the task of preparing, as specimens, some of the owls and hawks sent to the museum by an arrangement with Miner. To a young man with a tremendous respect for birds of prey this was a horrible experience. Handling Red-shouldered and Cooper's Hawks with badly mangled legs brought on a bitter feeling. To hear killing of this nature justified because of a hawk's "cruelty" to other birds was to him the result of gross ignorance of the natural order. "Human morals have no part in the rhythms and bounds of the natural world." (Terry Shortt personal communication to author September 1986.)
80. As one example of these results see George H. Harrison, editor, *Roger Tory Peterson's Dozen Birding Hot Spots: A guide to the 12 best locations in North America for amateur bird watching* (New York 1976). Illustrated black-and-white. See Harrison, author, "Point Pelee: Funnel to the North" and "Gaspe: Seabird Bastion". New York, 1976. Surveys of seabirds on the North Shore of the St. Lawrence and the Gaspé have been continuous since. The most recent accounts are: Gilles Chapdelaine and Pierre Brosseau. 1991. Thirteenth census of seabird populations in the sanctuaries of the North Shore of the Gulf of St. Lawrence, 1982-1988. Canadian Field-Naturalist 105(1): 60-66; Gilles Chapdelaine and Pierre Brousseau. 1992. Distribution, abundance, and changes of seabird populations of the Gaspé Peninsula. 1799 to 1989. Canadian Field-Naturalist 106(4): 427-434.
81. Charles W. Townsend "Notes on the Summer Birds of the Gaspe Peninsula, Province of Quebec" *The Canadian Field-Naturalist* 34: 78-80; 87-95 (1920). Taverner gave additional information when writing to Fleming: "Townsend on my advice is spending his honeymoon at Percé. He is delighted with it, the scenery, the people and the birds. Has added several species to the list and is going to work up the list. Have turned over my notes to him so that work will go on record, as it should have done before." Taverner to Fleming, 5 August 1919, ROM. When Townsend's first wife died in 1917 he gave up his medical work and devoted himself to bird study and travel. In 1919 he married his sister-in-law.

## Chapter 10

1. Taverner to Brooks, 12 April 1912, CMN.
2. Reviewed by W.E. Saunders in *The Ottawa Naturalist* 23: 225-228 (1910).
3. Elliot Coues *Key to the Birds of North America* 5th edition, 2 volumes (1903).
4. Taverner to Brooks, 19 March 1912, CMN.
5. Brooks to Taverner, 31 March 1912, CMN. Brooks was keen on military rifle shooting. See Marjorie Brooks "Allan Brooks — A Biography" *The Condor* 40: 15 (1938).
6. Taverner to Brooks, 12 April 1912, CMN.
7. Taverner to Fleming, 29 August 1912, ROM. Taverner wrote that he was delighted with his first meeting with Brooks. "He is all you have said of him and I am delighted to meet him and have a good bird talk with someone that is of some use. That he is a Canadian is so much the better". Also, 3 October 1912 in which Taverner said he was most favorably impressed with Brooks. "He is quite a man and I am glad to have a reliable one out there near the coast". [of British Columbia].
8. Taverner to Brooks 24 September; 8 December 1912. Brooks to Taverner 17 November; 14 December 1912, CMN.
9. Taverner to Fleming, 3 September 1913, ROM.
10. Taverner to Fleming, 5 September 1913, ROM.
11. Taverner to Brooks, 5 September 1913, CMN. By "picture work" he means "illustrations".
12. Taverner to Fleming, 23 September 1913, ROM.
13. Fleming to Taverner, 29 September 1913, ROM. In short, Fleming excused himself from collaboratiing in the project. He was only interested in writing a scholarly book for the serious collector which would take years to complete. Fleming realized that there was an urgent demand for a popular book but felt that Brooks and Taverner could write it between them with some help from himself when needed.
14. Brooks to Taverner, 16 October 1913, CMN.
15. Hamilton M. Laing *Allan Brooks: Artist Naturalist* British Columbia Provincial Museum, Victoria, page 106 (1979).
16. Taverner to Fleming, 2 September 1914, ROM. Taverner told Fleming that Brooks' eyesight and hearing were wonderful. He was forty-five years old. Taverner added "Too bad he had to get into this mix up but of course he is just the type of men that are wanted for the front just now".
17. The first set of prints of Hennessey's illustrations for Taverner's book (1919 edition) were by far the best. The plates for the second printing (1922) were less well coloured and clear.
18. Taverner to Fleming, 12 April 1915, ROM. For Taverner as a bird illustrator see Chapter 4 above, note 134.
19. Fleming to Taverner, 14 April 1915, ROM.
20. Taverner to Fleming, 17 April 1915, ROM.
21. Taverner to Swales, no date, but from internal evidence it was written in the spring of 1915, CMN.
22. Taverner to Fleming, 25 August 1915, ROM.
23. Fleming to Taverner, 30 August 1915, ROM.
24. Fleming to Taverner, 31 August 1915, ROM.
25. Fleming to Taverner, 14 September 1915, ROM.
26. Taverner to Saunders, 13 April 1915, CMN.
27. Taverner to Saunders, 17 May 1915, CMN.
28. Taverner to Fleming, 10 January 1916, ROM.
29. Fleming to Taverner, 20 January 1916, ROM.
30. Taverner to Fleming, 20 February 1916, ROM.
31. Taverner to Fleming, 25 February 1916. See Introduction to *Birds of Eastern Canada* pages 1-7.
32. Taverner to Fleming, 25 February 1916. Taverner wanted to guide the new wave of bird-watchers, who would be starting soon after the Great War, by the use of a reliable system. He wished to introduce them to the study of ornithology by showing them how to recognize *species* first. Later, as they became more experienced, they could study the fine points needed for distinguishing *subspecies* if they wished to.
33. Taverner to Fleming, 29 February 1916, ROM.
34. Taverner to Fleming, 14 March 1916, ROM. Although Taverner might respond quite sharply at first when his ideas were questioned he usually modified them somewhat, later.
35. Fleming to Taverner, 16 March 1916, ROM. Taverner explained that the egrets' plumes are grown only in the breeding season so that they can be obtained only in the vicinity of a breeding egretry. He described how they were taken: "The plume hunter usually hides in the rookery and with a small-calibre rifle shoots the birds one by one until the flock is exterminated. The plumes are torn from the bodies which are left to rot on the ground. The remaining young starve in the nests above ... A few years ago the waters of Florida and the Gulf states were made beautiful with the forms of these immaculate birds; today they have almost lost one of their greatest attractions as the birds are approaching extinction". P. A. Taverner *Birds of Eastern Canada* page 83 (1919). In contrast James Macoun advised Taverner that his book was just the place in which to make such appeal. J. M. Macoun to Taverner, 27 March 1916, CMN.
36. Fleming to Taverner, 16 March 1916, ROM.
37. Taverner to Fleming, 24 March 1916, ROM.
38. With a paper covered book it was quite normal at that period for the owner to get it bound. The volume could be trimmed to size at the time of binding. Taverner would usually bind his own copies.
39. Taverner to Fleming, 25 May 1916, ROM.
40. Taverner to Brooks, 15 May 1916, CMN.
41. Taverner to Fleming, 8 May 1917, ROM; Brooks to Taverner, 14 April 1917, CMN. About collecting, making up skins, and sending boxes of skins to Taverner.
42. Brooks to Taverner, 30 March 1918; 10 September 1918, CMN.
43. See note 15 above.
44. Taverner to Fleming, 5 July 1916, ROM.
45. Fleming to Taverner, 19 July 1916, ROM.
46. Taverner to Fleming, 24 July 1916, ROM.
47. Taverner to Brooks, 5 October 1916, CMN.
48. Fleming to Taverner, 5 October 1916, ROM.
49. Taverner to Fleming, 3 October 1916, ROM.
50. Fleming to Taverner, 5 October 1916, ROM.
51. Zaslow *Reading the Rocks* page 290. (See chapter 5, note 1)
52. Taverner to C.W. Townsend, 18 February 1917, CMN.
53. Taverner to Fleming, 6 February; 14 February 1917, ROM.

54. Taverner to Fleming, 9 June 1919, ROM.
55. Taverner to Brooks, 6 November 1919, CMN.
56. Louis Fuertes to Taverner, 28 November 1919, CMN.
57. Taverner to Fuertes, 1 December 1919, CMN.
58. Gordon Hewitt to Taverner, 25 November 1919, CMN. The first edition in English went out of stock in 1921 and was reprinted in 1922.
59. Taverner to R. W. Tufts, 28 February 1918 asking for a copy of his article "Notes on the birds of the Grand Pre region King's County, Nova Scotia" *Transactions of the Nova Scotia Institute of Science* 14: 154-199 (1917); Tufts to Taverner, 3 March 1918, CMN.
60. *The Auk* 37: 147-149 (1920).
61. *The Wilson Bulletin* Number 112: 101 (1920).
62. Robert Curry "In Memoriam: George Webster North (1910-1983)" *Ontario Birds* 2 (1984).
63. W. Earl Godfrey Introduction to *Taverner's Birds of Eastern Canada* Coles Canadiana Collection (Toronto 1974).
64. Taverner to Fleming, 24 March 1917, ROM.
65. P. A. Taverner *Birds of Eastern Canada* 177 (1919); 187 (1922). In the Coles edition entitled *Taverner's Birds of Eastern Canada* (1974) the species Lincoln's Sparrow is also shown on page 187.
66. P. A. Taverner *Birds of Eastern Canada* 168 (1919); page 178 (1922). In his Bird Journal of August 1906 Taverner noted his attempt to translate a goldfinch's song in human words: "I interpreted one of the little chatters of the goldfinch and think that I got it pretty close. It was flying over and as it passed it said plainly — "sweet, sweet, sweet, chew it, chew it". It is my maiden attempt", ROM.
67. This was Arthur W. Andrews the amateur entomologist in Detroit. Chapter 4, note 127 reference.
68. W. J. Cody and B. Boivin "The Canadian Field-Naturalist and its Predecessors" *The Canadian-Field Naturalist* 68: 127-132 (1954); this is about the *Transactions of the Ottawa Field-Naturalist Club* 1880-1887 (2 volumes); and *The Ottawa Naturalist* 1887-1919 (32 volumes). *Transactions* were largely speeches and reports delivered at soirees, it was not a journal; D. F. Brunton "Additions to the Documentation of the Publication History of the *Canadian Field-Naturalist* and its Predecessors". *Canadian Field-Naturalist* 100: 423-426 (1986).
69. Taverner to R. B. Horsfall, 14 March 1916, CMN.
70. Taverner to Fleming, 10 August 1918, ROM. "A few of us" referred to "the gang" consisting of Taverner, Jim (J. M.) Macoun, and Clyde Patch. They each guaranteed a number of new memberships to back up the argument for this change (and reduce opposition on financial grounds). J. M. Macoun underwrote 100 memberships; Taverner underwrote 25; Patch underwrote 25.
71. "Foreword" *The Ottawa Naturalist* 32: 1 (April 1918).
72. Taverner to F. L. Farley, 10 December 1918, CMN.
73. Taverner to R. W. Tufts, 11 December 1918, CMN.
74. Tufts to Taverner, 20 December 1918, CMN. By March 1919 the membership list had doubled from March 1918 to 540. Taverner had added 35 new members by then.
75. Taverner to Swales, 28 December 1918, CMN.
76. Taverner to Farley, 1 January 1919, CMN.
77. The new title came into effect with the publication of Volume 33, number 1 in April 1919.
78. Taverner to Fleming, 18 March 1919, ROM. The change was "moved by Mr. J. M. Macoun, seconded by Mr. Taverner, that the name of the Club publication be changed to the Canadian Field-Naturalist".
79. Fleming to Taverner, 24 March 1919, ROM.
80. Taverner to Fleming, 10 April 1919, ROM. When Taverner wrote that a general index would be a good thing, and that he thought he saw this in the future, he was very farsighted. It was finally published in 1979-1980. (I am grateful to Daniel Brunton for this information.)
81. *The Canadian Field-Naturalist* 33: 1 (April 1919). The jacket was designed by the Geological Survey artist, C. E. Johnson.
82. *The Ottawa Naturalist* 32: 118-126 (1919).
83. Letter Taverner to Fleming, 11 April 1917, ROM, in which he described the new martin house which he was about to put up. "Artistically", he wrote, "I think it is a success we will see what the Martins think about it."
84. I wish to thank Gerry Bennett of the Richmond Hill Naturalists for his gift to me of a copy of Taverner's article printed in the form of a 15 page pamphlet by National Parks branch (3rd edition 1922).
85. Taverner to Fleming, 23 August 1918, ROM.
86. Taverner "The Summer Birds of Hazelton BC" *The Condor* 21: 80-86 (1919).
87. *The Auk* 36: 1 (1919). P. B. Philipp and B. S. Bowdish "Further Notes on New Brunswick Birds"; J. A. Munro "Notes on some Birds of the Okanagan Valley, British Columbia"; P. A. Taverner "The Birds of the Red Deer River, Alberta" 36 (2): 248-265.

## Chapter 11

1. Taverner to Fleming, 16 March 1920, ROM. Fleming replied the following day, and said (in part): "Curious our ideas should coincide about each others letters. I have kept yours carefully. Someday we will edit them and fail to find a publisher".
2. J. D. Soper to Taverner, 13 January 1915, CMN.
3. Taverner to Soper, 18 January 1915, CMN.
4. P. A. Taverner "Suggestions for Ornithological Work in Canada" *The Ottawa Naturalist* 29: 14-18; 21-28 (1915). Also Chapter 7 above, notes 1-15.
5. Soper to Taverner, 6 February 1917, CMN.
6. Taverner to Soper, 18 February 1917, CMN.
7. Soper to Taverner, 23 November 1918; also 15 February 1919, CMN.
8. Fleming to Taverner, 16 December 1918, ROM. Laing's first visit to Fleming was in mid-June 1918. Richard Mackie *Hamilton Mack Laing: Hunter-Naturalist* (Victoria, British Columbia, 1985) Chapter 6. (Hereafter Mackie *Laing: Hunter-Naturalist.*)
9. Mackie *Laing: Hunter-Naturalist* pages 70-72. (See note 8)
10. H. M. Laing "Lake-shore Bird Migration at Beamsville, Ontario" *The Canadian Field-Naturalist* 34: 21-26 (1920).
11. P. A. Taverner "Hamilton M. Laing" *The Canadian Field-Naturalist* 33: 99-100 (1919).
12. Laing to Taverner, 18 August 1919, CMN.
13. Laing to Taverner, 19 June 1919, CMN.
14. For example Taverner to Laing, 22 March 1921, CMN.
15. Foster *Working for Wildlife* pages 161-163; 175-176. (See chapter 6 note 9)

16. Farley to Anderson, 18 November 1918, CMN. Francis La Grange Farley, born St. Thomas, Ontario 24 February 1870. Came to Red Deer, Alberta, in 1892 where he homesteaded before moving to Camrose, Alberta, in 1907. Lived there for the rest of his life. With encouragement from W.E. Saunders, Anderson and particularly Taverner he became an authority on the birds of Alberta. Obituary by J.D. Soper *Auk* 67: 218 (1950); see also W.K. Salt and A.L. Wilk *The Birds of Alberta* (Edmonton, 1958) page 51.
17. Taverner to Farley, 2 December 1918, CMN.
18. Farley to Taverner, 6 December 1918, CMN.
19. Taverner to Farley, 10 December 1918, CMN.
20. Farley to Taverner, 22 December 1918, CMN.
21. Farley to Taverner, 13 March 1919, CMN.
22. Taverner to Farley, 19 March 1919, CMN.
23. Taverner to Farley, 28 April 1919, CMN.
24. W. Rowan to Taverner, 21 November 1919, CMN. On Rowan see Marianne Ainley "Canada's First Avian Biologist" *Picoides* I: 6-8 (1987). He met Taverner and Hoyes Lloyd on 20 September 1920 in Edmonton. See Rowan's journal for evenings of 20 and 21 September.
25. Taverner to Rowan, 29 October 1920, CMN.
26. Fleming to Taverner, 20 January 1920, ROM. I have been unable to find any letter from Taverner to Fleming on whether he had any ambition to become chief of the Biological Division.
27. Taverner to Fleming, 23 January 1920, ROM.
28. Zaslow *Reading the Rocks* 353-357. (See chapter 5 note 1)
29. Taverner to Fleming, 18 February 1920, ROM. See also Lovat Dickson *The Museum Makers: The Story of the Royal Ontario Museum* (Toronto 1986) 36-39.
30. Taverner to Fleming, 1 March 1920, ROM.
31. Taverner to Fleming, 16 March 1920, ROM.
32. Taverner to Fleming, 22 March 1920, ROM. For information on Anderson's career to this point see Chapter 14 below.
33. Taverner to Fleming, 24 March 1920, last paragraph, ROM.
34. Taverner to Fleming, 25 March 1920, ROM. Collins was Director of the Geological Survey from 1920-1936, and concurrently acting Director of the Museum from 1925-1936. William Henry Collins b. 1878; graduate University of Toronto 1904; appointed to Geological Survey 1905; married 1908. His home on Rosedale Avenue was built to a design by Taverner in 1913-1914. Personal communication from Mrs. Ann Whitmore, daughter of W. H. Collins.
35. Taverner to Fleming, 16 April 1920, ROM. Taverner's optimism was based on a letter from H. H. Mitchell when he was planning a trip to the prairies the previous year.
36. Taverner to Fleming, 30 April 1920, ROM.
37. H. H. Mitchell's report as Provincial Naturalist in F. Bradshaw's report as Chief Game Warden in "Sixteenth Annual Report of the Department of the Province of Saskatchewan for year ending 30 April 1921. Regina 1921.
38. Canada. Department of Mines *Annual Report Year Ended 1921* page 27.
39. Percy Taverner to Mrs. Ida V.C. Taverner and Miss I. Taverner, 6 August 1920 (written from Elkwater Lake, Cypress Hill, Alberta), CMN.
40. Taverner to his mother and sister, 7 August to 15 September 1920, CMN.
41. Taverner to his mother and sister, 12-15 September 1920, CMN. Two anecdotes about Taverner on this prairie trip in the model T Ford were told me by Elizabeth Lloyd, who heard them from her father. While Hoyes Lloyd was driving the Model T Ford in the prairies, with Taverner in the passenger's seat, they began approaching a level crossing. Each agreed to look out in case of an oncoming train on his side of the tracks. Hoyes Lloyd called out "all clear", while Taverner was stuck on the sound "heh-heh-heh" as a train approached on his side. Lloyd sensed there was something wrong by the urgency in Taverner's voice, and brought the car to a sudden stop just as the train rumbled over the crossing, and Taverner shouted "heh-heh-here she comes Lloyd". One other story relayed by Elizabeth Lloyd about her father and Taverner on a camping trip is worth retelling.

    While Lloyd drove the Ford, cranked it by hand, and saw to its needs, Taverner did the camp cooking, which included buying food and milk. One evening they camped near a farm which Lloyd had visited previously. He knew that the farmer stuttered, and realized that if Taverner went to the farm to buy milk, and the two men started to talk, there might be trouble, even a fight. So he made an excuse for going to buy the milk himself, leaving Taverner to guard the Ford car and their equipment.
42. William Rowan "Field Notes" 20 September 1920, University of Alberta Archives, William Rowan Papers Number 69-16-761. I am grateful to Dr. Marianne Ainley for giving me this reference.
43. Taverner to Fleming, 28 October 1920, ROM.
44. Fleming to Taverner, 31 October 1920, ROM.
45. Fleming to Taverner, 21 November 1920, ROM. The first three pages of this letter read rather like a film script. Because of his anxiety over security Fleming had not written to Taverner while he was in Manitoba "in case the letter went astray", and it was left to Hoyes Lloyd to explain the scheme to him when they met at Banff in July 1920.
46. Taverner to Fleming, 29 November 1920, ROM.
47. Zaslow *Reading the Rocks* (see chapter 5, note 1) page 353 right column to page 354 left column, with a photograph of William McInnes.
48. Zaslow *Reading the Rocks* (see chapter 5 note 1) pages 354-357. In these pages Morris Zaslow gives some perceptive insights into the effects of the subordination of the museum under the Survey.
49. Taverner to Fleming, 10 April 1919, ROM. Nevertheless Brooks was very conscious of the valuable time he had lost during the war. When Taverner and Fleming tried to persuade him to join them at the AOU meeting in New York he declined because, he explained, "I have lost 5 precious years — some thing, at my time of life. I am going to quit rifle shooting, big game, everything but bird work for the future ..." (Brooks to Taverner, 13 October 1919, CMN.)
50. Brooks to Taverner, 25 September 1919, CMN.
51. Taverner to Brooks, 6 October 1919, CMN. Ornithologists needed to have sets of birds in various plumages from downy young to fully mature male and female specimens in pre-nuptial moult, breeding

plumage, post-nuptial moult and winter plumage. Without such a range available for comparisons ornithologists could make misidentifications. See Christopher Leahy *The Birdwatcher's Companion* pages 580-584. Bonanza Books, New York, 1982.

52. P. A. Taverner "The Evening Grosbeak in Canada" *The Canadian Field-Naturalist* 35: 42-45 (1921). Taverner discussed a western and an eastern form, and attributed the spread of Evening Grosbeaks east of Lake Superior to the "recent" spread of the Manitoba Maple (*Acer negundo* Linnaeus), the winged seeds of which the birds ate. This article was referred to 65 years later in the *Atlas of the Breeding Birds of Ontario* (University of Waterloo Press, 1987) page 502.
53. Taverner to Brooks, 24 October 1919, CMN. In the same letter he said "If you leave publication altogether to the half baked you cannot complain when mistakes creep in. I think it is up to you to correct many of the popular, or the unpopular British Columbia mistakes."
54. Brooks to Taverner, October 28 1919, CMN.
55. Taverner to Brooks, 6 November 1919, CMN.
56. Taverner to Brooks, 30 September 1921, CMN.
57. Taverner to Brooks, 6 December 1922, CMN. When Taverner wrote "111 Stellar's Jays' he did not mean that the National Museum had that number of specimens in its trays. The majority would be on loan from collectors such as Brooks and from other museums. For subspecies of Stellar's Jays in the 1920s see Taverner *Birds of Western Canada* pages 257-258; for the 1980s see Godfrey *The Birds of Canada* (1986) page 382.
58. What Taverner meant by saying that "too many people are guided by specific preconceptions" probably refers to people who expect a subspecies to be found in geographical areas, and therefore call specimens taken from that area what they expect them to be. They do not face the facts of a careful study of a specimen's measurements and plumage and comparisons with a series of other specimens.
59. Brooks to Taverner, 17 December 1922, CMN.
60. Taverner to Brooks, 27 December 1922, CMN. "Slightly colour-blind" is not a meaningful term. Perhaps a more accurate measure of colour perception would be to use relative terms such as below average, average, above average.
61. Taverner compounded his challenge by writing a letter to the Editor of *The Auk* enclosing a copy of the statement entitled "The Genus Debased" together with the signatures of 28 leading systematic research workers of the A.O.U. Some minor revisions were suggested by four of these. Also sent to the editor was a copy of Taverner's covering letters accompanying the statement "The Genus Debased". All three letters were published in *The Auk* in the Correspondence section, under the signature of P. A. Taverner. *The Auk* 40: 177-80 (1923).
62. Brooks to Taverner, 17 December 1922, CMN. This was almost one year after Taverner had circularized his statement to leading systematic research workers of the AOU.
63. Mackie *Laing: Hunter-Naturalist* (see note 8) pages 80-81.
64. See L. B. Potter "Notes on Birds in Southwestern Saskatchewan" *The Canadian Field-Naturalist* 36: 94-95 (1922). This is a short notice on the valley of the Frenchman River, and the Sage Grouse, Rosy Finches, and wintering Horned Lark he had observed there.
65. Mackie *Laing: Hunter-Naturalist* (see note 8) page 81-82; Taverner to Rowan, 21 October 1921, CMN.
66. Taverner to Laing, 20 September 1921, CMN. Taverner and Brooks worked out a draft list of birds they considered should be illustrated in *Birds of Western Canada* while Taverner was visiting Brooks.
67. Marjorie Brooks "Allan Brooks — A Biography" *The Condor* 40: 16 (1938).
68. Taverner to Brooks, 8 December 1921, CMN. Brooks asked Taverner to draw up plans for a building 25 × 18 yards that could be easily heated, have a working window to give a good northern light, a work bench, and windows to face N.E. and E. (Brooks to Taverner, 16 January 1922). Taverner sent the plans of the building, with specifications, on 3 February 1922.
69. Brooks to Taverner, 3 August 1921, CMN.
70. Taverner to Brooks, 30 September 1921, CMN. He reported that Anderson was still on an expedition collecting in New Brunswick with Young.
71. Harry Schelwald Swarth (1878-1935). Fellow of the AOU. Curator of Birds, Museum of Vertebrate Zoology, Berkely, California 1908-1913, 1916-1927; Curator Department of Ornithology and Mammology, California Academy of Sciences, San Francisco 1927-1935. Obituary in *The Auk* 54: 127-134 (1937). The Skeena River rises in the northern interior of British Columbia, flows S.W. for 58 km and into the Pacific Ocean at Prince Rupert.
72. Brooks to Taverner, 26 November 1921, CMN. In his letter Brooks copied verbatim the words Swarth used about Brooks' museum.
73. Taverner to Brooks, 8 December 1921, CMN. The Minister of Mines from 1920-1921 was Sir James A. Lougheed, lawyer and Conservative leader in the Senate from 1906-1921.
74. Taverner to Brooks, 17 February 1922, CMN. There was little improvement, if any, during Taverner's lifetime.
75. Taverner to Laing, 7 December 1921, CMN.
76. H. M. Laing *Allan Brooks: Artist Naturalist* (British Columbia Provincial Museum, 1979) page 2. Laing described collecting in 1922 with Brooks and Taverner in Chapter 1 "The Okanagan".
77. Laing *Allan Brooks* pages 3-4: Taverner *Birds of Western Canada,* Page 241 on the White-throated Swift; Godfrey *The Birds of Canada* (1986) on the distribution of the White-throated Swift in the 1980s.
78. Taverner to Mrs. Ida V. C. Taverner, late May 1922, CMN. For a good photo of Brooks, Taverner, Farley, Laing, Gartell, Sampson at Vaseux Lake, see Laing *Allan Brooks* (note 76) page 4.
79. Taverner to his mother, 4 June 1922, CMN.
80. Mackie Laing: *Hunter-Naturalist* 85. (See note 8)
81. Taverner *Birds of Western Canada* 1926 pages 208-209.
82. Laing *Allan Brooks* page 6. (See note 76)
83. For a fuller account see Laing *Allan Brooks* pages 5-6.
84. At Brooks' home Taverner was able to look at his collection of skins in the specimen cabinets which,

according to Laing, showed the stamp of perfection on every tray. A photo taken around 1924 shows three trays of specimens, and the caption "The Brooks Collection set high standards in the quality and uniformity of its specimens". From Laing *Allan Brooks* pages 158; 160. (See note 76)

85. On Harkin's philosophy for wildlife preservation see Foster *Working for Wildlife* pages 216-219; 222. (See chapter 6 note 9)
86. Taverner to Mrs. Ida V. C. Taverner, 4 June 1922, CMN.
87. Taverner to his mother, 17 June. McAstocken was an engineer on the Kettle ValleyRailroad and offered to take Taverner on the engine to Hope, which McAstocken said was "a very wonderful bit of railroad run". A cayuse was a western Indian pony.
88. This was Dr. Charles Saunders of the Experimental Farm. The man referred to was J. H. Parham, an expatriate Englishman and gentleman fruit-rancher. Taverner was to hear from him again in the 1930s.
89. *Phalacrocorax pelagicus*. Specimen no. 123. The species was described by Taverner in *Birds of Western Canada* pages 72-73.
90. In 1909 Seton published *Life Histories of North American Animals*, in 2 volumes, about the fifty-nine species he had found in Manitoba. Later he began revising and expanding these volumes with much new information. This was his main occupation in 1922 when he visited Taverner at the National Museum. The main theme of his lectures now was on the need for conservation of wild creatures. The first volume of his new work *Lives of Game Animals* was published in 1925. Taverner and Seton had much in common to discuss.
91. Laing to Taverner, 6 January 1923, CMN. "A beaut" — slang. Abbreviation for "a beauty".
92. Laing to Taverner, 6 January 1923, CMN.
93. Taverner to Laing, 3 February 1923, CMN.

## Chapter 12

1. Taverner to Brooks, 6 February 1922, CMN.
2. Taverner to Brooks, 27 September 1922, CMN.
3. Taverner to Brooks, 14 March 1923, CMN. In *Birds of Eastern Canada* a paragraph was given under the heading *Distinctions* while a few lines were given to *Field Marks*. As an example see Bonaparte's Gull and how to distinguish it from other eastern gulls, and from the [Black-legged] Kittiwake. Under *Field Marks* he wrote "Size, black hood in summer adults, white on forward edge of wings, and bill and feet colour on other plumages make the most valuable field characters for recognition in life" (page 54). In *Birds of Western Canada* a good example is Franklin's Gull where the same plan is followed, and a paragraph is given on how to distinguish it from the Bonaparte's Gull.
4. Louis A. Fuertes to Taverner, 27 January 1924, CMN. In a two-page letter he enclosed sketches and tracings from some of the material in his portfolio. On a separate sheet he made drawings "as the outlines seem to me". But these, he said, were mere suggestions, and added: "You said a lot when you remarked that no two people see alike, nor fasten on the same details as field-recognition marks. Its the 'cut of the jib', and a very subtle thing, that enables the old hand to spot species of hawks, or ducks ... it shouldn't be expected that outlines, or the written word, will take the place of that good old teacher — hard work and experience."
5. Taverner to Brooks, 5 February 1924, CMN.
6. Taverner to Laing, 12 February 1924, CMN.
7. Taverner to Brooks, 14 March 1923, CMN.
8. Taverner to Brooks, 3 August 1923, CMN.
9. Taverner to Brooks, 2 September 1923, CMN.
10. Brooks to Taverner, 5 January 1923, CMN.
11. Taverner to Brooks, 16 October 1923, CMN. Brooks had painted a Marbled Godwit in breeding plumage. Taverner said that the base of the beak should be bright orange, and the legs almost black. He sent the plate back for alterations which Brooks carried out.
12. Brooks to Taverner, 25 November 1924, CMN. (Plate XXXI by Brooks' reference). This contains hand written notes by Brooks on suggested changes, and additions. Under Ruby-crowned Kinglet Brooks wrote, "I find the interrupted eye-ring of this bird an arresting field mark". He illustrated this with a miniature pencil-drawing of the bird's head showing the interrupted eye-ring clearly. In just a quick sketch Brooks achieved an unmistakable kinglet head. (Brooks reference number 989.) Brooks' note of praise for Taverner's "habit-portraits" comes at the end of this part.
13. Taverner to Brooks, 22 February 1924, CMN.
14. Taverner to Brooks, 3 August 1923, CMN.
15. Taverner to Brooks, 16 October 1923, CMN. "Sot", a word sometimes used by English people as a joke on the Scots pronunciation of the word "set".
16. Brooks to Taverner, 8 January 1924, CMN.
17. Taverner to L. L. Snyder, 12 February 1924, CMN. The Third AOU Check-list of 1910 contained four species and fourteen subspecies of the genus *Junco*.
18. For an example of his sense of fun see Taverner's letters to Laing of 25 November and 18 December 1924, CMN, on the subject of government accountants. Laing had submitted his accounts for the summer of 1924 somewhat late, with a letter of explanation to Taverner. Taverner replied that it was no good sending him a letter of explanation since he had no pull with the accountant, and continued: "Accountants are important fellows. I think they are stuffed with red-tape inside instead of the usual guts".
19. Taverner to Brooks, 26 November 1923, CMN.
20. Marianne G. Ainley "William Rowan: Canada's First Avian Biologist" *Picoides* 1: 6-8 (1987).
21. Rowan to Taverner, 13 March 1922, CMN.
22. Taverner to Rowan, 23 August 1922, CMN.
23. Rowan to Taverner, 8 November 1922, CMN.
24. Taverner to Rowan, 15 May 1922, CMN.
25. Rowan to Taverner, 8 March 1922, CMN. On the subject of introduced birds Rowan wrote: "Thence onwards I hope to keep a systematic cheque on further movements ..." .
26. Rowan to Taverner, 23 January 1923, CMN.
27. Taverner to Rowan, 2 February 1923, CMN.
28. Rowan to Taverner, 21 February 1923, CMN.
29. A battle of words in *The Canadian Field-Naturalist*, 1923-1924, was sparked by J. A. Munro's article "The Necessity for Vermin Control on Bird Sanctuaries", followed by an editorial comment from Harrison Lewis, and "letters to the editor". See Chapter 15, note 72.

30. Taverner to Rowan, 19 January 1924, CMN. Presumably the movement for wildlife preservation at that time.
31. Taverner to Rowan, 17 March 1924, CMN.
32. Rowan to Taverner, 27 March 1924, CMN.
33. Lloyd to Taverner, no date, probably early April 1924, CMN.
34. Taverner to Rowan, 21 April 1924, CMN.
35. Taverner to L.L. Bolton, 31 December 1925, CMN. Bolton was assistant deputy minister, Department of Mines, with F.J. Nicholas, editor of publications of the Geological Survey Branch under him. Zaslow, *Reading the Rocks* page 353. (See chapter 5, note 1)
36. Taverner to Brooks, 31 December 1925, CMN. "Seance" here in the sense of "a meeting for exhibition or investigation of spiritual phenomena" which shows Taverner's sceptical sense of humour.
37. Brooks to Taverner, 23 May 1925, CMN.
38. Taverner to Brooks, 18 November 1925, CMN. Audubon died in 1862. His widow, Lucy, had little money left and offered most of his original drawings to the New York Historical Society for five thousand dollars, but eventually accepted two thousand, which was more than anyone else would offer her. In this way the Society preserved the originals for future generations to see. Information in Alexander Adams *John James Audubon: a Biography* (New York and Toronto 1966) page 470.
39. Brooks to Taverner, 18 January 1926, CMN.
40. Taverner to Brooks, 18 January 1926, CMN.
41. Taverner to Brooks, 13 March 1926, CMN. In the same letter Taverner made suggestions for improving the [American] Golden Plover illustration.
42. Taverner to Brooks, 22 February 1924, CMN; Taverner to Rowan, 22 February 1924, CMN. The Biological Board of Canada was established in 1912; it ran permanent biological stations at St. Andrews, New Brunswick and Nanaimo, British Columbia. In 1937 the Biological Board became the Fisheries Research Board. This manual, under various titles, was to engage Taverner's attention, from time to time, until the end of his life.
43. Taverner to Fleming, 25 August 1924, ROM. Also Taverner to Rowan in which he related the trip, and discussed cameras.
44. Taverner to Tufts, 19 April 1924, CMN.
45. Tufts to Taverner, 12 May 1924, CMN. This was a hard hitting letter. Although Taverner put as good a face on it as possible Tufts' injured feelings were only "somewhat" soothed. For a outline of the latter's career see W. Earl Godfrey, 1984. A tribute to Robie Wilfred Tufts, 1884-1982. Canadian Field-Naturalist 98(4): 513-518.
46. Taverner to Tufts, 11 June 1924, CMN.
47. Taverner to Fleming, 25 August 1924, ROM.
48. Taverner to Fleming, 23 September 1924, ROM.
49. Taverner to Brooks, 17 September 1924, CMN.
50. Brooks to Taverner, 24 September 1924, CMN.
51. I am grateful to Daniel Brunton of Ottawa for this information.
52. A photograph of their house in Detroit taken in 1906 exists, and one of their house in Ottawa when it was almost complete in the fall of 1912. A coloured photo of the same house taken from much the same angle in 1988 shows no major change.
53. Taverner to Brooks, 6 December 1922, CMN; Taverner to Laing, 28 December 1922, CMN.
54. I am grateful to Miss Elizabeth Lloyd for giving me a copy of this photograph. The date 22 August 1923 is written on it in ink.
55. Note by Ida Taverner in *Guest Book at Hyla, Blue Sea Lake Book I* (1917-1924) dated 30 October 1923. Property of Corwin Ferguson who kindly loaned it to me.
56. Brooks to Taverner, 26 November 1922, CMN.
57. Taverner to Laing, 12 January 1926, CMN.
58. Taverner to Laing, 11 December 1925, CMN. On this expedition see H.M. Laing "Birds Collected and Observed During the Cruise of the Thiepval in the North Pacific, 1924" in Canada, National Museum Bulletin Number 40, 1925; Mackie *Hamilton Laing* pages 88-96. (See chapter 11 note 8)
59. On H. S. Swarth see Chapter 11 note 71. Atlin Lake is at the northern boundary of British Columbia and Alaska. See Laing *Allan Brooks* pages 148-156. (See chapter 11 note 8)
60. It was given the common name of Timberline Sparrow and described by Swarth and Brooks in *The Condor* 27: 67 (1925). Its range was given as breeding at high altitudes in the Atlin district of northwestern B.C. Also as occurring in southeastern B.C., and Madison County, Montana, in migration.
61. A. C. Brooks and H. S. Swarth "A Distributional List of the Birds of British Columbia" *Pacific Coast Avifauna* 17: 1-58 (1925), Cooper Ornithological Club; Taverner to Brooks, 15 December 1925, CMN.
62. Taverner to Brooks, 25 November 1924, CMN. In the same letter he encouraged Brooks to paint larger pictures once in a while, and added "Size may not impress the discriminating critic but it does the masses and it is the masses who buy."
63. Taverner to Fuertes, 25 November 1924, CMN.
64. Fuertes to Taverner, 10 December 1924, CMN.
65. Brooks to Taverner, 6 May 1925, CMN.
66. Taverner to Brooks, 13 May 1925, CMN.
67. Brooks to Taverner, 4 June 1925, CMN.
68. Taverner to Rowan, 17 September 1924, CMN. For Rowan's notes on birds found at Beaverhills Lake 1924-1925 see Robert Lister *The Birds and Birders of Beaverhills Lake* (Edmonton, 1979) pages 51-60. Taverner got valuable records for use in *Birds of Western Canada* from Rowan in these years.
69. Rowan to Taverner, 13 February 1924, CMN.
70. Marianne Gosztonyi Ainley *From Natural History to Avian Biology: Canadian Ornithology 1860-1950* 222-225. Thesis submitted in partial fulfillment of the requirements of the degree of Doctor of Philosophy McGill University 1985.
71. Gustave Eifrig "Is Photoperiodism a factor in the migration of birds?" *The Auk* 61: 439-444 (1924).
72. Rowan to Taverner, 14 February 1925, CMN. See Marianne Ainley "Rowan vs Tory: Conflicting Views of Scientific Research in Canada, 1920-1935" *Journal of History of Canadian Science, Technology and Medicine* 12(1): 11-12 (1988) on difficulties caused by Tory's attitude to his ornithological research.
73. Cyril Guy Harrold (1895-1929). Obituary, with photograph, by B.W. Cartwright and A. G. Lawrence *The Canadian Field-Naturalist* 43: 132-133 (1929); Robert Lister *The Birds and Birders of Beaverhills*

*Lake* (Edmonton 1979) pages 31-34; 44-68 (quoting from Rowan's field notes). In 1925 Harrold was paid the minimum rate for a junior zoologist which was $105 per month, until it was raised to $110. Anderson to Taverner, August 1925, CMN. The name of the lake was spelt as Beaverhills by Rowan, Lister and others. The name had been changed to Beaverhill — singular — before Lister's book was published in 1979.

74. Taverner to Ida Clare Taverner, 15 August 1925, ROM. (written from Red Deer River). Sternberg had a long and distinguished career as a paleontologist at the National Museum of Canada: *see* tribute by Loris S. Russell. 1982. "Charles Mortan Sternberg, 1885-1981". *The Canadian Field-Naturalist* 96(4): 483-486 and bibliography compiled by Richard Gordon Day *The Canadian Field-Naturalist* 96(4): 487-489.
75. Lister *Beaverhills Lake* (see note 73) page 165-166, quoting Rowan's field notes.
76. Lister (see note 73), page 166, but quoting Lister's own words.
77. Rowan, talk at Calgary 1955. Copy of relevant text kindly sent to me by Marianne Ainley.
78. Taverner to Ida Clare, 12 September 1925, ROM. Siwash. A derogatory term 1) as noun. North American Indian 2) as verb. To camp out, travelling light and using only natural shelter.
79. H. M. Laing *The Canadian Alpine Journal* 15: 99-114 (1925); H. M. Laing, P. A. Taverner, R. M. Anderson "Birds and Mammals of the Mount Logan Expedition, 1925" Canada, National Museum *Annual Report* for 1927, pages 69-71; H. M. Laing and P. A. Taverner "Notes on Birds collected and observed in Chitina River Region, Alaska" *Annual Report* for 1927, pages 72-95. Total number of birds collected was 203. Laing shot nearly 4000 feet of film which was edited by Allen Carpe, representative of the American Alpine Club, into a film *The Conquest of Mount Logan.*
    On the 1992 Mount Logan expedition see article by Michael Schmidt, expedition leader, with coloured photographs by Pat Morrow, entitled "To the Top" *Canadian Geographic* Sept/Oct 1992, pages 22-35. The text reads well, the photos are superb.
80. Canada Department of Mines, National Museum *Annual Report* for 1925, page 45.
81. Taverner to Bishop, 23 October 1925; 18 November 1925, CMN.
82. Brooks to Taverner, 18 January 1926, CMN. The article was by W. H. A. Preece "January Bird Notes from Mount Tolmie, Victoria, B.C." 39: 175-176 (1925). The fact that House Wren and Chipping Sparrow were listed for January but no mention was made of Seattle Wren [Bewick's Wren] and Tree Sparrow tells its own tale.
83. Taverner to Brooks, 10 February 1926, CMN. The Editors of the journal were Harrison Lewis 1922-1925; F. J. Nicholas 1925; G. A. Miller 1925-1928; Douglas Leechman 1928-1938. Taverner was an Associate Editor (for ornithology) until 1942, when he was succeeded by A. L. Rand.
84. Taverner to Camsell, 5 December 1922; 6 January 1923, CMN.
85. Joyce Reddoch "Dow's Swamp" *Trail and Landscape* 12: 133-141 (1978), Ottawa. I am grateful to Daniel Brunton for bringing this article to my attention, and for supplying information from his own knowledge on the early history of the Ottawa Field Naturalists' Club. See also C. H. D. Clarke. 1965. "A requiem for Dow's Swamp". *Canadian Field-Naturalist* 79(1): 1-3.
86. Gustave Langelier to Taverner, 7 May 1923, CMN.
87. Taverner to Bernadette Langelier, 18 June 1923, CMN. Taverner said that this was a considerable extension of range for that species "as the nearest Canadian record I have for it is Montreal where it is only accidental". A sight record, he said, "would always have left a strong element of doubt in the question".
88. Taverner to Gustave Langelier, 17 October 1923, CMN.
89. Taverner to Langelier, 4 December 1925, CMN.
90. Taverner to Bent, 15 March 1922, CMN. Taverner said that he would need to see various species in various plumages at the museum, and also discuss the distribution of species in Canada with Taverner's maps and files in front of him. In a letter of 22 March 1922 Taverner told Bent that he had about half the Canadian species plotted.
91. Bent to Taverner, 20 March 1922, CMN. During 1923 Taverner wrote 12 letters to Bent.
92. P. A. Taverner "Ornithological Investigations near Belvedere, Alberta, 1926", Canada Department of Mines, National Museum *Annual Report 1926* (1928) pages 84-104. This is a list of birds observed, with brief annotations. The Connecticut Warbler was noted as a common breeding bird; several nests were found. For a description of the work there see letter Taverner to Bishop, 5 August 1926, CMN.
93. A one-page account by H. E. Mullet appeared in *The Edmonton Journal* 24 July 1926. It was reproduced, in part, by Lister *Birds of Beaverhills Lake* pages 61-66. Rowan wrote his own account to explain the reasons for the mass banding, and the difficulties the banders experienced in William Rowan "Banding Franklin's Gulls in Alberta" *The Wilson Bulletin* 39: 44-49, 1927.
94. Anderson to Taverner, 19 June 1926, CMN.
95. Taverner to Fleming, 19 March 1926, ROM.

## Chapter 13

1. T. S. Palmer "The Forty-Fourth Stated Meeting of the American Ornithologists' Union" *The Auk* 44: 73-84 (1927). Hereafter "T. S. Palmer Report". It includes a full transcript of the programme of events. The Honourable Charles Stewart M.P. was both Minister of Mines *and* the Interior from 1921-1936 with the exception of a short period in 1926.
2. Hoyes Lloyd "The 44th Stated Meeting of the American Ornithologists' Union" *The Canadian Field-Naturalist* 40: 189-191 (1926). Hereafter "H. Lloyd. Report on meeting".
3. T. S. Palmer "Report" (see note 1) pages 74; 84.
4. T. S. Palmer "Report" (see note 1) pages 74-75.
5. T. S. Palmer "Report" (see note 1) page 75, which was accompanied by a plate (IV) showing the Great Auk perched on the three volumes.
6. T. S. Palmer "Report" (see note 1), pages 79-82, lists all the papers presented by title, together with the name and address of the speaker and his institution.
7. Ruthven Deane's collection of portraits of North American ornithologists numbered over one thou-

sand, and was presented to the Library of Congress in 1934. It was deposited in the Division of Fine Arts, and was provided with a card index which gave basic data on each person. See In Memoriam notice for R. Dean in *The Auk* 52: 1-14 (1935).

8. These were listed, with a brief introduction, in a catalogue entitled
**EXHIBITION OF BIRD ART**
Held in connection with the 44th Meeting of the
AMERICAN ORNITHOLOGISTS' UNION
VICTORIA MEMORIAL MUSEUM
For information on items under "Historical Collection loaned by the Emma Shearer Wood Library of Ornithology, McGill University Library, Montreal", see that catalogue pages 2-3.
9. Exhibited in advance of the AOU meeting at a conversazione of the Professional Institute of the Civil Service of Canada held in the museum in mid April 1926. More than eight hundred guests, from the technical services of government and from both Houses of Parliament, with their wives, attended.
10. These formed part of a larger collection of Brooks' paintings commissioned by Robb which were later presented by him to the Royal Ontario Museum. They are currently preserved in the Department of Ornithology there. They measure 9 × 12 inches and appear to have been painted in a rather dramatic style with noticeable colour effects in the background, as though designed as people pleasers. Or perhaps Brooks suited these paintings to Robb's romantic nature. See page 10 of the catalogue (see note 8) of the exhibition where the name of each species is given.
11. This library was started by Dr. Casey Albert Wood (1856-1942) who had studied medicine at McGill University, Montreal. His first evidence of an interest in birds was a paper of his on the eye and eyesight of birds published in *Ophthalmology* in 1907. This work culminated in his book *The fundus oculi of birds ... ; a study of comparative anatomy and physiology* in folio, illustrated by 145 drawings and 61 coloured plates, 1917. Dr. Wood joined the AOU in 1917 and was elected a member in 1921.

    In 1920 he founded and endowed the Emma Shearer Wood Library of Ornithology, based on his own ornithological library, which he presented to McGill University. It was named in honour of his wife Emma Shearer of Montreal. For further information on Dr. Wood see S. L. McAtee *The Auk* 59: 611-12 (1942); Eleanor MacLean *History of the Blacker-Wood Library* (typewritten, May 1988) 8 pages. As librarian of the Blacker-Wood , Eleanor MacLean has written an excellent account of its founding and continual extention in the 1920s and 30s. I wish to thank Ms. MacLean for giving me a copy of her paper and for showing me round the Blacker-Wood library of Biology. Correspondence between Casey Wood and P. A. Taverner is preserved in the Blacker-Wood Library under Taverner, and in the Taverner papers at the National Museum, Ottawa under Casey Wood.
12. H. Lloyd "Report on meeting" page 190. (See note 2)
13. T. S. Palmer "Report" page 76. (See note 1)
14. A copy of the group photograph of 48 Canadian AOU members at the 1926 meeting in Ottawa is preserved in the ROM Library, Archives section, together with a numbered list of each member's name, typewritten. Title: "Key to the Canadian Group Photograph taken at the A.O.U. 1926 Convention, reading from left to right".
15. The Auklet 2 (1926) page 14.
16. The Auklet (1926) page 16.
17. The Auklet (1926) page 15. William Edwin Saunders, "Will" or "W. E." to his close friends, came from a family with interests in entomology, botany, horticulture and experimental agriculture. His father was largely responsible for the first Federal Experimental Farm being established in Ottawa in 1886, and was appointed Director. One brother, Charles, became famous for his plant-breeding experiments over many years which led him into developing Marquis wheat. Another brother, Percy Saunders, a professor of chemistry, became an authority on peonies, irises and phlox. W. E. was the naturalist of the family. Taverner wrote a warm appreciation of him when he died. See *The Auk* 61: 345-351 (1944).
18. Brooks to Taverner, 28 July 1923, CMN.
19. Taverner to Brooks, 3 August 1923, CMN. Taverner was referring to *The Canadian Field-Naturalist* when he wrote the words "our badly needed subscription list".

    Wallace Havelock Robb (1888-1976) was born in Belleville, Ontario, son of William Doig Robb, an official of the Grand Trunk Railway Company. He was interested in bird life from boyhood, and in 1921 he joined Herbert K. Job, the representative of the American Audubon Society, on a photographic expedition to the Magdalen Islands, in the Gulf of the St. Lawrence. The success of this trip diverted Robb away from business, in which he had done very well, and turned him towards poetry and birds. Robb could afford to pay a first-class wildlife artist to produce 32 bird paintings to exhibit at the AOU meeting in Ottawa, and in this way bring himself into the limelight. He was ambitious to establish "a bigger and better and finer Bird-lore in Canada and run it in his own way" (See note 20).

    Robb's first book of poems *The Quill and the Candle; Poems of Birdland in Canada* was published by Ryerson Press in 1927. Here is an example of a verse: 'I dreamed of a Birdland Garden fair/With a lily lagoon and a dragon-fly;/And a mystical Heron was standing there/As I went by'. Here is a second: 'A lone loon calls,/And rocky walls/Return the mournful sound./He grieves away The dying day; / And darkness creeps around.' (Robb's poetry was very similar to that known in England in the years ca. 1917-1926 as "late Georgian verse". Critics scorned it as being "flabby" — it was slack in technique, false in its simplicity and shallow in feeling, among other weaknesses. There is no full biography of Robb, but George F. G. Stanley read a paper before the Kingston Historical Society at which the poet was present. See George Francis Gilman Stanley *The abbe of Abbey Dawn*. The Kingston Historical Society 1970.
20. Taverner to Brooks, 7 February 1925, CMN.
21. Robb to Taverner, mid-October 1926, CMN. One obvious cause of Robb's complaint of the "derogatory style" of *The Auklet* was an item with the title "A Poem by Walter Hardrock Rod, Poet and Naturalist".

This poem was distinguished by the repetition *ad nauseam* of the refrain "Are you there?" "Are you there?" *The Auklet* 2 (October 1926) page 22.

22. Taverner to Robb, 21 October 1926. This letter shows Taverner as an experienced letter-writer. In two sentences he made clear the functions of *The Auklet*. It was to check AOU members from taking themselves too seriously, and becoming stuffy and pompous. Then, in two paragraphs, he drew an understanding sketch of Brooks — his nature, traits and character. Without directly criticizing Robb he was able to deflate him neatly. Whether Robb had enough perception to realize that his fulsome oratory in presenting this commercially sponsored award to Brooks was irksome is impossible to tell. Taverner gave Robb just a glimmer of praise for his collection, but no more.
23. In 1926 this consisted of Kingswood, Mackenzie King's summer cottage beside Kingsmere Lake, built in 1903 while King was still a civil servant. In 1928 King moved to Moorside, the showplace of his estates. The names Kingsmere Lake and King Mountain were not named after Mackenzie King but were in use as early as 1905.
24. Taverner to Laing, 23 October 1926, CMN.
25. On Big Island see chapter 7, page 156.
26. Taverner to Laing, 23 October 1926, CMN.
27. Taverner to Thompson Seton, 21 October 1926, CMN.
28. T. S. Palmer *The Auk* 44: 82-84 (1927).
29. Taverner to Laing, 23 October 1926, CMN. Writing to Fleming on 28 October Taverner explained: "The smooth working of everything was due to Lloyd's executive ability and Patch's work. Most of the ideas were mine but I could not have carried them out so well had it not been for the able assistance I had from the above and the Department."
30. Rowan to Fleming, 3 October 1926, ROM. See M.G. Ainley "Rowan vs Tory: Conflicting Views of Scientific Research in Canada, 1920-1935" *Scientia Canadensis* 12 (1): 3-21 (1988). This article explains why Rowan thought that it was unwise for him to attend the AOU meeting.
31. Taverner to Rowan, 22 October 1926, CMN. Also Rowan to Taverner, 2 November 1926 asking "Why take my joke about the Yankee Pie so seriously?"
32. Taverner to Bishop, 21 October 1926, CMN. Kipling wrote this at the time of Queen Victoria's Golden Jubilee celebration in 1897 to warn his fellow countrymen not to be boastful and drunk with the power of the British Empire. The third verse reads: "Far-called, our navies melt away/ On dune and headland sinks the fire/ Lo, all our pomp of yesterday/ Is one with Nineveh and Tyre/ Judge of the Nations, spare us yet/ Lest we forget — lest we forget."
33. H. S. Swarth *The Condor* 29: 84-85 (1927).
34. W. Stone *The Auk* 44: 126 (1927).
35. Anderson to Ada Johnson, 18 July 1927, NAC, Manuscript Division, MG 30 B40, R.M. Anderson Papers, Volume 4, page 3.
36. See Chapter 12 note 49.
37. Taverner to Ida Clare Taverner, 15 August 1925, CMN.
38. Taverner to Munro, 25 February 1927, CMN; Taverner to Bishop (same subject), 1 March 1927, CMN.
39. Taverner to Bishop, 9 May 1927, CMN.
40. Taverner to Fleming, undated, ROM. Fleming wrote on it in pencil "Aug 1927". Taverner also mentioned a photograph of himself which he had taken for the old lady.
41. Taverner to Bishop, 16 August 1927, CMN.
42. Taverner to Fleming, 4 October 1927, ROM.
43. Taverner to Fleming. For a description of their visit to Yosemite National Park see Taverner to Laing, 25 November 1927, CMN.
44. From the fact that Taverner was staying with a *relative*, and that his own name at birth was *Fowler*, we can deduce that his father had, at some point, married Mrs. Fowler.
45. Saunders to Fleming, 17 September 1924, ROM.
46. Laing to Taverner, 15 April 1926, CMN.
47. Taverner to Fleming, 1 April 1927, ROM. Also at the wedding was Richard S. Finnie, at that time starting his career of arctic explorer and writer, and Hughie Margetts of the RCMP who was Dewey Soper's best man. All three shared a hair-raising experience during a voyage in C.G.S. *Arctic*, Captain Joseph E. Bernier, taking Soper to Pangnirtung, Baffin Island, in 1924. See Chapter 14. It was a great occasion for all three when they met again in the home of Percy and Ida Taverner in Ottawa. The bride was Carolyn Freeman of Wetaskiwin, near Edmonton. See Richard S. Finnie "In Memoriam: J. Dewey Soper 1893-1982". *The Musk-Ox* 31: 80-82 (1982). University of Saskatchewan, Institute for Northern Studies, Publication Number 2.
48. Taverner to Munro, 25 February 1927, CMN.
49. Taverner to Laing, 21 April 1927, CMN.
50. Taverner to Laing, 12 May 1928, CMN.
51. I was in touch with David McLeish of Toronto and Beaumaris who is a relative of John McLeish.
52. Taverner to Fleming, 7 March 1930, ROM.
53. *The Gopher*, newspaper of the Liggett School, Volume 8,Number 7, 30 April 1930, page 3. For Martha Hohly Wiest see Chapter 4.
54. Taverner to Munro, 7 March 1930, CMN.
55. Laing to Taverner, 4 April 1930, CMN. The reference to "on Dec. 9th last" is to a letter of that date which Taverner sent to Laing. He must have been feeling "down in the dumps" when he wrote it, because what he meant to be light- hearted banter had a jaundiced quality about it.
56. I am grateful to Miss Elizabeth Lloyd for showing me a copy of the Taverner wedding card which her parents preserved.
57. Information in letter Taverner to Brooks, 28 March 1930, CMN.

## Chapter 14

1. Shelagh D. Grant *Sovereignty or Security? Government Policy in the Canadian North*. (University of British Columbia Press, Vancouver 1988) pages 5-6.
2. See Zaslow, *Reading the Rocks*, pages 173-175. (See chapter 5 note 1) The expedition wintered at Cape Fullerton on the northwest side of Hudson Bay. In the summer of 1904 the *Neptune* explored in Baffin Bay, and landed members of the expedition at Cape Herschel, Ellesmere Island. Here a document, taking formal possession of it for the Dominion was read, and the Canadian flag raised and saluted. See photo-

graph page 174, and map showing the routes of the *Neptune*, and places where stops were made. Collections of rocks and fossils were made, as well as of northern birds, eggs and nests, and biological material. In his "Summary Report for 1913" Taverner reported that the Zoological Division had received by exchange from the Department of Marine and Fisheries, the birds and eggs collected by A. P. Low during the voyage of the S.S. *Neptune* in 1904.

3. See Zaslow, *The Opening of the Canadian North, 1870-1914*, Toronto/ Montreal, 1971; pages 264-267. The wording of the plaque is shown on page 267. A photograph of the tablet on Melville Island, with the ship's company standing in front of the Union Jack and the Dominion Flag, is printed in an article on "Arctic Sovereignty" in *The Canadian Encyclopedia* Hurtig 2nd Edition 1988, Volume 1, page 113. There is only one person sitting down at the front of the photo wearing a school cap. Presumably this is Frank Hennessey. On Bernier see Zaslow *Opening of the Canadian North* pages 261-277.
4. Taverner to Fleming, 24 February 1912, ROM. There is some corroborative evidence of this. Thomas McIlwraith wrote to John Macoun of the Geological Survey, at its Sussex Street headquarters, where the small museum was housed, a long letter about the importance for Canada to establish a national museum where exhibits of her natural productions could be properly classified and arranged. He gave Macoun some very forthright advice: The position of Naturalist, to which he had been promoted (1887) was well deserved, McIlwraith said, "but you are responsible for the *condition* of the museum [emphasis added], and the country will look to you to have it in such shape as will not bring reproach on us from strangers from other countries while visiting the capital." (pages 1-2). Near the end of this letter he said: "I would advise you by all means to stay at home and get the museum hammered into the shape you would like to see it." (page 6). But that is exactly what Macoun was not prepared to do. He continued making collecting expeditions until nearly the end of his life and Taverner had taken over the care of the birds and mammals from him. On the state of the museum accommodation of the Geological Survey see Waiser, *The Field Naturalist. John Macoun, the Geological Survey, and Natural Science* (Toronto, 1989) pages 120-142. Near the end of his life Macoun began dictating his autobiography. Speaking about the years 1882-1884 he said: the skins of birds, that I brought, were spread out by me on a table ... where the draughting group was, and, after a time, were placed in long drawers that were in the old Museum, and, in the course of time, with Dr. Bell's specimens of birds, collected on Hudson's Bay, *were destroyed almost wholly by insects, and the remainder burned.*" [emphasis added]. *John Macoun, Autobiography of John Macoun, Canadian Explorer and Naturalist 1831-1920*. Ottawa Field Naturalist Club, 1922, pages 219-220. I am grateful to Daniel Brunton for information on this subject.
5. Taverner to Fleming, 30 December 1920; and 15 January 1921, ROM.
6. Taverner to Bent, 15 January 1921, CMN.
7. Bent to Taverner, 2 January 1921; Taverner to Bent, 12 March 1921, CMN.
8. National Archives of Canada, R. M. Anderson Papers "Personal Record Card". MG 30 B 40, Volume 13, File 8 and 10. These typewritten Personnel Record Cards were composed by Anderson; file 8 was prepared about 1920, consisting of one page of his military record and one page of family information. F.10 was prepared in 1931 for the office of the Minister of Mines, W. A. Gordon. It was revised and copied out in October 1936. This contains considerable information about his antecedents, including his mother and her family, and several of his uncles, one page about his academic training, one about his post graduate experiences, and several pages of detail about his executive and administrative experience from 1908 to 1927. Anderson's papers in the National Archives at Ottawa are extensive, and can be searched with the help of Finding Aid Number 340 which mentions the main subjects of 39 volumes. In contrast Taverner, and his widow, preserved no personal files, and no "Personnel Record Cards", while no collection of Taverner Papers exists in the National Archives of Canada.
9. Rudolph Martin Anderson *The Birds of Iowa*. A Thesis submitted to the Faculty of the Graduate College of the State University of Iowa, in partial fulfillment of the requirements for the degree of Doctor of Philosophy. Proceedings of the Davenport Academy of Sciences, Davenport, Iowa, Volume 11 March 1907, pages 125-417. Paperbound 292 pages. It recorded 355 species and subspecies known to occur more or less regularly in the state, plus 44 species of casual occurrence. Consult *The Literature of Iowa Birds: A Complete Record of the Writings of the Birds of Iowa*. By Paul Bartsch, Iowa University, 1889.
10. On the "Birds of Point Pelee" see Chapter 4 above, pages 65-67. It was reviewed by J. A. Allen in *The Auk* 26: 98-99 (1909).
11. For information on Anderson's first experience of the arctic (1908-1912) see Richard J. Diubaldo *Stefansson and the Canadian Arctic* McGill-Queen's University Press, Montreal, 1978, chapter 3, especially 39-42, and note 27. I wish to acknowledge here the use I have made of Richard Diubaldo's valuable account of the part played by R. M. Anderson in arctic exploration with V. Stefansson from 1908 onwards. Also Vilhjalmur Stefansson *My Life with the Eskimo* New York Macmillan 1912; 1913 and 1945. On Anderson's second thoughts in the spring of 1913 about going to the arctic with Stefansson again see Diubaldo page 95.
12. On the preparations for the Canadian Arctic Expedition see Diubaldo chapter 4, especially pages 62-68 (See note 11). Also Trevor H. Levere "Vilhjalmur Stefansson, the Continental Shelf, and a New Arctic Continent" *BJHS* 21 (1988) pages 238-240; Zaslow *Reading the Rocks* pages 319-325. (See chapter 5 note 1)
13. Diubaldo (see note 11) pages 75-82 provides details of events leading to the confrontation between Stefansson and Anderson at Collinson Point in March 1914.
14. See Diubaldo (note 11).
15. Dr. Joel Asaph Allen (1838-1921) was a founder of the AOU and President for the first seven years of its existence. Editor of *The Auk* for 28 years, and editor

of three editions of the AOU Check-list. Curator of Birds and Mammals at the American Museum of Natural History from 1885 until his death.

16. Taverner to Fleming, 27 February and 3 March 1913, ROM.
17. Canada, *Sessional Paper 1913*, "Summary Report of for 1914". R. M. Anderson: "Report on the Canadian Arctic Expedition 1913-14", pages 163-165. Diamond Jenness, anthropologist with the Southern Party, collected about 50 birds in 1914, including [Northern] Pintail, Harlequin [Duck], Red Phalarope, Parasitic Jaeger, Peregrine Falcon, Sabine's Gull etc. mainly from Barter Island, northern Alaska. I am grateful to Stuart Jenness for this information.
18. Anderson to Taverner, 10 January 1915 (from Bernard Harbour, Northwest Territory). CMN., P. A. Taverner Archive. On Barren Ground bears see page 3 of letter. On a "distinct population known as the barren-ground grizzly" see A. W. F. Banfield, 1974, *The Mammals of Canada*, University of Toronto Press, pages 310-311.
19. Anderson wrote a report on the work carried out by the Southern Party which was published in 1917. See R. M. Anderson "Recent Exploration on the Canadian Arctic Coast" *The Geographic Review* 4(4): 241-266 (1917). In the final paragraph he wrote: "We were well loaded down when we left Bernard Harbour on the evening of July 13, 1916. We made a quick and easy voyage out: Baillie Island, June 24; Herschel Island, July 28; Point Barrow, August 8; and Nome, August 15." Here their schooner was left to be sold while the men and specimens travelled via the Alaska and British Columbia Inside Passage to Victoria and Seattle.
20. Taverner to Brooks, early October 1916, CMN.
21. Foster *Working for Wildlife* pages 161-164 (See chapter 6 note 9). Duncan Campbell Scott, poet, short story writer and civil servant. Joined the federal Department of Indian Affairs in 1875, became deputy superintendent in 1913 and held that post until his retirement in 1932.
22. See Chapter 7 above, page 163; Foster pages 159-164. (See chapter 6 note 9)
23. See Chapter 7 above, page 153.
24. National Archives of Canada. R. M. Anderson "Papers, Personnel Record Card" MG 30 B40, Volume 13, file 10. Anderson made a preliminary reconnaissance of this large area in 1917. See Anderson to Fleming, 4 September 1918, ROM.
25. Anderson to Fleming, 4 September 1918, ROM.
26. Anderson to Fleming, 27 March 1919, ROM. Also Soper to Taverner, 12 April 1919, CMN.
27. Taverner to Fleming, 5 April 1919, ROM. Also see Waiser *The Field Naturalist* pages 198-200. (See chapter 5 note 2)
28. Their house in Ottawa was at 58 Driveway, and their cottage was built on Lot 18, Big Island, Blue Sea Lake.
29. See Chapter 7, page 157. For more detail see Waiser *The Field Naturalist* 199-200 (see chapter 5 note 2). The quotation is part of a longer one given by Dr. Waiser on page 200, from a letter by Taverner to Brooks.
30. For an account of the situation in the museum in 1920 see Chapter 11.
31. Taverner to Fleming, 16 March 1920, ROM.
32. The next few pages have been based largely on Richard Diubaldo, *Stefansson and the Canadian Arctic*. In a letter to his wife, Mae Belle, from the Arctic, Anderson wrote that Stefansson had caught him at a very unfavourable time to make any compromise with him. Stefansson had just brought him some mail which contained her letter telling him the sad news that their baby son had died three days after birth. As a result Anderson felt "hard and bitter". He felt quite guilty when he thought of her lonely condition. "I had counted on the boy being some company for you," he wrote. (Letter Anderson to Mrs. Anderson, 28 June 1914, as quoted in Diubaldo (see note 11) page 99.)
33. Letter Mrs. Anderson to Mrs. A. Allstrand, 5 January 1922, quoted in Diubaldo (see note 11) page 196. Also see Diubaldo pages 188-205 for details on Stefansson's return to Canada in 1918, the publication of *The Friendly Arctic*, and Jenness' long letter in the journal *Science* challenging many of Stefansson's statements in his book.
34. Diubaldo (see note 11), pages 200-204.
35. Letter Brock to Camsell, 24 April 1923, quoted in Diubaldo (see note 11) page 205.
36. In 1919 Anderson was writing reports on arctic mammals, and part of a report on arctic birds, but volume 2 of the reports on the Arctic Expedition (mammals and birds) to be edited by Anderson, never materialized. As late as 1940, in an article in *Ibis*, Allan Brooks deplored the parsimony of the Canadian Government in not publishing Anderson's Arctic report. Taverner, in reply, wrote: "In this case at least it is not the government's fault but Anderson's. In spite of the Department pressing him to do so he has never presented a report for publication. He edited all the other reports of the expedition but had never prepared one for himself. It is quite inexplicable."
Zaslow *Reading the Rocks* (see chapter 5 note 1) pages 324-325 has given one answer, Diubaldo in *Stefansson* (see note 11) page 195 another. To this day Anderson's action seems "quite inexplicable".
37. Until late 1921 his letters to Fleming had mainly been about wildlife and conservation, but in 1985 I discovered that the Fleming collection in the Royal Ontario Museum contained typewritten letters from Anderson to Fleming which give a good idea of how very upset Anderson felt about Stefansson's account of the Arctic Expedition.
38. Anderson to Fleming, 9 November 1921, ROM. In this, and subsequent letters, the differences between the standards, attitudes, perhaps also the natures of Anderson and Stefansson begin to show clearly. The word "fake" or faker" in this series of letters is one that seems to have a special meaning. It occurs in his letters again later in his life. It has the connotation of a dishonest person, someone who should not be trusted.
39. Diubaldo (see note 11) page 209. His excellent chapter "Conclusion" runs from pages 209-215.
40. On this see Taverner to Rowan, 20 April 1923, CMN; Taverner to Brooks, 4 July and 16 October 1923, CMN; Brooks to Taverner, 25 August 1923, CMN.
41. Taverner to Fleming, 25 August 1924, ROM.
42. P. A. Taverner "Annual Report" 1925, page 46-48; Taverner to Brooks, 24 October 1925, CMN; Brooks to Taverner, 3 November 1925, CMN.

43. Taverner to Bishop, 21 October 1926, CMN.
44. See Chapter 13.
45. Mae Belle Anderson to Rudolph Anderson, 10 August 1926. NAC. R. M. Anderson Papers. MC 30 B 40 Volume 4, file 2.
46. M. B. Anderson to R. M. Anderson, 6 July 1926, NAC. Mrs. Anderson spelt Karel's name "Carl".
47 M. B. Anderson to R. M. Anderson, 1 November 1926, NAC.
48. M. B. Anderson to R.M. Anderson, 2 November 1926, NAC. During the AOU meeting Taverner played a major part, especially with the gift of a copy of *Birds of Western Canada* to each AOU member. Mrs. Anderson may have been indignant at this because her husband did not appear to have shone particularly, and did not have anything published to display.
49. Anderson to H. P. Allstrand, 19 August 1927, CMN. His height, according to his certificate of naturalization, when he became a Canadian citizen, was 6 feet. When he wrote "knock on wood" what was he intending?
50. Laing's side of the matter is given in Mackie *H. M. Laing* (see chapter 11 note 8) pages 94-96.
51. Taverner to Laing, 8 February 1927, CMN.
52. Laing to Taverner, 28 February 1927, CMN.
53. Mackie *H. M. Laing* (see chapter 11 note 8) pages 101-102.
54. Taverner to Laing, 31 March 1927, CMN.
55. Laing to Taverner, 7 April 1927, CMN.
56. Taverner to Laing, 21 April 1927, CMN. Also Mackie *H. M. Laing* (see chapter 11 note 8) pages 110-111.
57. Taverner to Laing, 6 October 1927, CMN.
58. Laing to Taverner, 27 February 1928, CMN.
59. Canadian Museum of Nature, P. A. Taverner archive. As well as the original, a microfilm of this Register of Birds also exists. I am grateful to Dr. W. Waiser for bringing my attention to this Register, and for loaning me his own microfilm copy.
60. J. Dewey Soper "Discovery of the Breeding Grounds of the Blue Goose" *The Canadian Field-Naturalist* 44: 1-5 (1930).
61. A. C. Bent "Life Histories of North American Wild Fowl" Order Anseres (Part 2). United States National Museum, Bulletin 130, Washington 1925. Bent stated what little was known of the breeding ground of Blue Geese in 1925 on pages 178-180. For detailed study see F. Cooke "Genetic Studies of Birds — the Goose with Blue Genes" *Acta XIX Congressus Internationalis Ornithologici*, Volume I, Ottawa 1986, pages 189-214. Of special interest to Soper's discovery see pages 208-211.
62. J. Dewey Soper "Adventuring in Baffin Island" *Canadian Geographical Journal* 1: 191-206 (1930), with 16 excellent photographs.
63. Soper to Taverner, 18 July 1929, CMN, from Camp Kungovik, West Coast Baffin Island Latitude — 65° 35[1] 1929. See Appendix 1 for photocopy of original letter complete.
64. On B. Hantzsch see R. M. Anderson "The Work of Bernard Hantzsch in Arctic Ornithology" *The Auk* 45: 450-466 (1928). Hantzsch River and Taverner Bay are marked on sketch map in D. Soper *Canadian Geographical Journal*, (3): 194 (1930). Anderson Headland is marked on sketch map in D. Soper *The Canadian Field-Naturalist* 44: 2 (1930).
65. Kennard to Soper, 10 October 1929, CMN. Soper replied to Kennard, 29 October 1929, that the authorities might dispose of some of the "Blue Goose" material to other institutions, but he could not be certain. At that date the whole collection belonged to the Department of the Interior. For information on Kennard's work on the geese of the genus *Chen* see A. C. Bent "In Memoriam: Frederick Hedge Kennard 1865-1937" *The Auk* 54: 345-346 (1937). The eventual ownership of the collection was decided at a meeting in November 1929. See Appendix 2.
66. R. M. Anderson *Annual Report 1928* pages 10-11.
67. Taverner to Fleming, 25 September 1929, ROM. Taverner kept a Journal of his voyage. Volume 1 has an itinerary, volume 2 analysis of species. On Taverner's study of the migration routes of the Hudsonian Curlew [Whimbrel] see Chapter 16 below.
68. P. A. Taverner "Some Zoological Aspects of the Canadian Arctic Expedition of 1929" *Canadian Field-Naturalist* 44: 25-28, 1 plate (1930).
69. Taverner to Munro, 7 March 1930, CMN. Taverner mentioned the new Hudson Bay railway from The Pas to Churchill.
70. Taverner to Laing, 9 January 1931, CMN.
71. Percy A. Taverner and George M. Sutton *The Birds of Churchill Manitoba*. Annals of the Carnegie Museum 23: 1-83, 13 pls 1 map (1934).
72. Taverner to W. H. Collins, 19 February 1930, CMN.
73. Taverner to H. H. Mitchell, 6 February 1930, CMN.
74. Albert Lloyd, who went with Taverner to Hudson Bay in 1930, continued in subsequent years under Clyde Todd and became a permanent member of the Carnegie Museum staff. Arthur Twomey, a student of Rowan at the University of Alberta, did field work at Hudson Bay in 1930, then attended the University of Illinois where he received his Ph. D. He later took part in expeditions to the Hudson Bay area under the auspices of the Carnegie Museum. This material based on Marianne G. Ainley *From Natural History to Avian Biology: Canadian Ornithology 1860-1950*, Ph.D. dissertation, McGill University 1985, pages 133-136, which I gratefully acknowledge.
75. Canada, Sessional Paper 1911 "Summary Report for 1910".
76. Taverner to Collins, 6 December 1929, CMN.
77. Deputy Minister of the Interior H. H. Rowatt to Deputy Minister of Mines Charles Camsell, 27 June 1933. National Archives of Canada, Charles Camsell papers. If Anderson was shown the letter he was not likely to have been pleased to find Taverner referred to as "the best person in the service to undertake this work" i.e., to write about birds of the eastern Arctic.
78. Translated from the German by L. H. Neatby as *My Life Among the Eskimos*. Institute of Northern Studies, University of Saskatchewan, Saskatoon, 1977.
79. Taverner "The Birds of the Arctic Islands". Unpublished typescript dated 1933. CMN. P. A. Taverner archive. This is a 16 page "Introduction", but contains no list of birds.
80. *Canada"s Eastern Arctic. Its History, Resources, Population and Administration.* Assembled by W. C. Bethune for the Northwest Territories Council and

issued by the Department of the Interior, Ottawa, 1934. Taverner's contribution is on pages 113-128.

81. W. B. Alexander to Taverner, 25 November 1933, CMN.; Taverner to Alexander, 6 December 1933, CMN.
82. Taverner to Fleming, 11 December 1929, ROM. The Corn Crake (*Crex crex*) formerly known as "casual or straggler" in the autumn along the east coast of North America, now considered as "accidental". *The Audubon Society Master Guide to Birding*. See National Geographic Society *Field Guide to the Birds of North America* 1983, page 98 and illustration. On a Barnacle Goose taken near Cape Dorset, August 1924 see P. A. Taverner "Some Recent Canadian Records", *The Auk* 44: 217-228 (1927).
83. Taverner to Rowan, 22 May 1931, CMN.
84. Department of Mines, *Annual Report* 1931-2, pages 1-2, as quoted in Zaslow, *Reading the Rocks* (see chapter 5 note 1) page 361; also pages 373-374.
85. Zaslow *Reading the Rocks* pages 356-357.
86. Letter Watson Seller, Assistant Deputy Minister, Department of Finance to Charles Camsell, Deputy Minister of Mines, 18 August 1931, NAC, Camsell Papers, RG 45, Volume 49; L. L. Bolton to W. Sellar, 21 August 1931; L. L. Bolton to Charles Camsell, 22 August, 1931, NAC, Camsell Papers. The language in which these letters were written is a shining example of civil service gobbledygook, well worth including in an anthology of examples of that genre.
87. Personal interview with Hugh S. Bostock, 17 September 1984, and tape recording. Bostock was a member of the Geological Survey Canada 1926-1965. Stationed southern B.C. until 1930; Yukon and the Territory 1931 until 1965. Promoted Assistant Chief Geologist 1950. Author of *Pack Horse Tracks*. Geological Survey of Canada 1979. For biographical information see "Foreword" by D. J. McLaren, and "Author's Preface". Although Bostock could not have been at Taverner's confrontation with Camsell he could well have heard of the episode from someone else. The sight of Taverner, agitated and stammering, while "balling out" the Deputy Minister of Mines, must have been an experience to remember.
88. Letters Taverner to Laing, 30 May 1935, CMN; Taverner to Laing, 30 April 1936 where this is explained more fully.
89. Draft letter Taverner to Collins, undated, unsigned. Even if a complete version of his was never sent Taverner had written other letters to Collins at this period. The correspondence between Collins and Taverner in the years 1926-1936 was quite a large one.
90. From 1935 onwards Anderson carried out a major attack on Taverner — on paper. Although Taverner guessed at some of the things Anderson said about him, he had no clear idea of their content or extent. Much of the information used in the following notes has come from Dr. and Mrs. Anderson's correspondence which was donated to the National Archive of Canada by members of their family after their death. (Finding Aid N 340) It was just as well that Taverner died without knowing the contents of these letters. In addition several revealing letters from Anderson to Laing, written between 1935-1936 are in the Public Records of British Columbia. I am grateful to Richard Mackie, author of *Hamilton Mack Laing: Hunter Naturalist* (see chapter 11 note 8) for bringing these letters to my notice.
91. Taverner to Laing, 30 April 1936, CMN. By this time some of Taverner's friends were warning him that Anderson was writing in derogatory terms about him.
92. Taverner to Laing, 18 May 1936, CMN. This was wishful thinking on Taverner's part because Anderson had already written several letters to Laing expressing his contempt for Taverner, not so much in terms of a personal disagreement, but rather because Taverner was not up to his job as the museum's ornithologist, as well as more unpleasant insinuations. I do not know the extent of truth or untruth in these statements.
93. Taverner to Laing, 18 May 1936. What exactly Taverner meant by this is unclear.
94. Taverner to Brooks, 26 September 1936, CMN.
95. For a fuller account, with a reorganization chart and a photograph of John McLeish, see Zaslow *Reading the Rocks* (see chapter 5 note 1) pages 377-381. For a brief biography of him see Chapter 17, note 41.
96. Memorandum: Status of Division of Biology, National Museum of Canada. From R. M. Anderson, Chief, Division of Biology, National Museum of Canada. To Dr. Charles Camsell, Department of Mines. NAC, MG 30 B40 Volume 14, file 20. See Appendix 3 where the main points of Anderson's memorandum have been briefly noted.
97. Taverner to Brooks, 20 April 1937, CMN.
98. This was his "Record Book" started in 1931 and ending at his retirement in 1942. In this hand written log book Taverner kept a note of anything he wanted to have a note on. For 1936 there were 6 pages; 1937, 30; 1938, 12 pages. Michel Gosselin of the Ornithological Section found this Record Book among Taverner's papers. CMN, P. A. Taverner Archive.
99. Taverner to Lynch, 13 July 1935, CMN. This letter was based on a letter from Taverner to Brooks dated 27 June 1935 in which he told Brooks very clearly that he (Brooks) was too generous in donating specimens to the museum. Taverner said that he felt guilty in accepting all Brooks' gifts to the museum. Anderson's position on the matter of exchanges of specimens was different, and was made clear in a memorandum on "Exchanges and Gifts of museum specimens" dated 28 April 1936 and signed R. M. Anderson.
100. On the subject of the preparation of specimens for storage see R.M. Anderson *Methods of collecting and preserving vertebrate animals* National Museum of Canada 1931; fourth edition 1965, Biological Series number 18, Bulletin number 69. Anderson devoted chapter 4 to methods of collecting and preserving birds.
101. See Appendix 3.

## Chapter 15

1. Taverner to Ida Clare Taverner, 10 June 1928, CMN.
2. National Museum of Canada *Annual Report 1928*, page 12. (Bulletin number 62). Ottawa, 1929.
3. Taverner to Charles Townsend, 4 September 1928, CMN.
4. Taverner to Bishop, 6 September 1928, CMN. Glover Allen was Curator of Mammals, Museum of

Comparative Zoology, Harvard; Francis Allen, Publisher with Houghton Mifflin Co., Boston; Frederick Kennard was a specialist on geese of the genus *Chen*, and Harry Oberholser, United States National Museum. In addition to those staying at Amory's, Arthur Allen of the Cornell University Zoological Department, was on the north shore for a while working with H. F. Lewis who, in his official post, had the use of a boat. Todd worked the "Canadian Labrador" from Natashquan eastward. See note 9 for explanation of the term Canadian Labrador.

5. Taverner to Glover Allen, 7 September 1928, CMN.
6. Glover Allen to Taverner, 26 September 1928, CMN. For Northern Lapwing see note by Taverner in *The Auk* 46: 231 (1928). Also Taverner *The Auk* 46: 223 (1929) on the Razorbill.
7. Taverner to Glover Allen, 16 October 1928, CMN.
8. P. A. Taverner "Bird Notes from the Canadian Labrador, 1928", *The Canadian Field-Naturalist* 43: 74-79 (1929). Taverner acknowledged that Harrold assisted him. Writing to Frank Bradshaw after Harrold's death, Taverner praised his tireless work.
9. P. A. Taverner "Bird Notes from the Canadian Labrador, 1928" *The Canadian Field-Naturalist* 43: 74-79 (1929).
10. Copley Amory to Taverner, 18 September 1931, CMN. For a report on the conference by R. M. Anderson see NMC *Annual Report 1931* (Bulletin Number 70) Ottawa 1932, pages 11-12.
11. Taverner to Laing, 28 November 1931, CMN.
12. Taverner to Brooks, 3 August 1931, CMN. Also Taverner to Rowan, 8 July 1931, CMN.
13. Taverner to Laing, 29 June 1933, CMN.
14. Taverner to Laing, 3 July 1934, CMN.
15. Taverner to Munro, 17 June 1935, CMN.
16. Taverner to Laing, 13 November 1936, CMN.
17. Taverner to Soper, 27 October 1936, CMN.
18. Taverner to Laing, 6 October 1931, CMN. Dr. Eidmann was attending the Matamek Conference in 1931. Writing to Fleming, Taverner said that he was a forest entomologist from Munich, "of very broad interests and quite delightful". (Taverner to Fleming, 24 September 1931, CMN.)
19. Taverner to Laing, 22 April 1932, CMN.
20. The "Unfinished" refers to Schubert's symphony of that name. Other melodies that Taverner used to whistle, while doing field work, were from the "Ode to Joy" in Beethoven's Ninth Symphony, and from Brahms' Symphony No. 1, which he considered one of the finest symphonies.
21. Taverner to Laing, 22 April 1932, CMN.
22. Taverner to Laing, 18 January 1933, CMN.
23. Taverner to Laing, 13 April 1933, CMN.
24. Tavermer to Laing, 1 May 1933, CMN.
25. Taverner to Saunders, 18 February 1932, CMN.
26. Taverner to Laing, 22 April 1932, CMN.
27. Anderson to Kenneth Racey, 11 February 1937, CMN.
28. Taverner to Laing, 2 January 1935, CMN.
29. See note 36 below.
30. Taverner to Brooks, 18 February 1932, CMN.
31. Brooks to Taverner, 15 July 1924, CMN.
32. Taverner to Brooks, 7 February 1925, CMN. This letter contains two pages of details on *calurus* and *harlani* as Taverner understood them then.
33. Taverner to Brooks, 31 December 1925, CMN. Important in showing how to illustrate birds diagrammatically.
34. Taverner to Brooks, 7 February and 31 December 1925, CMN. Taverner had known N. A. Wood at Ann Arbor while a student there. See Chapter 3.
35. P. A. Taverner *Birds of Western Canada* 1926 and revised edition 1928 page 193; also Taverner's *Birds of Western Canada* reprinted by Coles Publishing Company, 1974, same page.
36. P. A. Taverner *A Study of Buteo borealis, the Red-tailed Hawk, and its varieties in Canada*. Canada Department of Mines, Museum Bulletin Number 48, 1927. With 3 pages of colour illustrations of tails.
37. Taverner *Study of Red-tailed Hawk* (see note 36) page 3.
38. Witmer Stone *The Auk* 45: 244-245 (1928). This refers to Taverner calling the western race *harlani*, and regarding it as identical with the melanistic phase of *calurus*, but giving *harlani* precedence over it for reasons of priority, because the name *harlani* was published earlier than the name *calurus*.
39. H. S. Swarth *The Condor* 30: 197-199 (1928).
40. Presumably at the Museum of the University of Michigan since he acknowledged such a courtesy in his paper. Also this subspecies was described by Van Tyne in Occasional Papers of the Museum of Zoology Number 321, University of Michigan 1935 page 1. *Buteo harlani* was mentioned briefly in the *Thirty-Second Supplement to the Check-list* page 106. Mentioned in *The Auk* 90: 411-419 (1973). Also see R. S. Palmer (Editor) 1988 *Handbook of North American Birds* Volume 5. Yale University Press, New Haven, pages 100-105.
41. Taverner to Rowan, 19 January 1924, CMN. The first two pages are about the Cackling Goose, and how Brooks distinguished it from Hutchin's Goose. Taverner did not feel that A. C. Bent himself was well informed on Hutchin's Goose: "It is a case where intimate field knowledge has to supplement closet experience", Taverner wrote. Brooks "certainly had superior field knowledge of the Cackling and Hutchin's".
42. *Birds of Western Canada* page 109.
43. P. A. Taverner "A study of *Branta canadensis* (Linnaeus) the Canada Goose (Based upon breeding or summering specimens) Illustrations. Plate I *Branta canadensis*, the Canada Goose. Figure 1. Typical bills of the races of the *Branta canadensis* group." (Bulletin National Museum of Canada, number 67, pages 28-40, 1931.)
44. "A study" (see note 43) pages 31.
45. "A study" (see note 43) pages 39-40.
46. "A study" (see note 43) page 40 — at end of study. Authorities since Taverner's study generally treat the Cackling and Richardson"s Geese as subspecies, not separate species.
47. Taverner to Rowan, 6 October 1931, CMN.
48. *Birds of Canada* page 86. Its nesting ground was not discovered until 1938.
49. Taverner to Brooks, March 1933, CMN.
50. Brooks to Taverner, 14 June 1933, CMN.
51. Taverner to Brooks, 28 June 1933, CMN.
52. W. E. C. Todd "A new eastern race of the Canada Goose" *The Auk* 55: 661–662 (1938). The reasons

why Todd discovered a subspecies of the *Branta canadensis* from eastern Canada that was different from the one already recognized by Taverner were explained by Todd on page 661. He said that Taverner's study was based on breeding specimens, but since he apparently had no breeding specimens for eastern Canada and Newfoundland his remarks on typical *canadensis* referred to examples from inland and western localities. But the Canada Geese which migrate along the Atlantic coast and breed in Newfoundland and Labrador were not the same as those which migrate through the interior and breed on the east coast of Hudson Bay. "The former are light-colored birds; the latter by comparison are dark-colored". Todd then determined the type locality of the original *canadensis* and then separated the *Branta canadensis interior* as a subspecies (page 662).

53. Jean Delacour *American Museum Novitates* 1537, page 7 (1951). Colusa, California.
54. Same. Delacour's *B. c. taverneri* was not recognized in the Fifth AOU Check-list of 1957.
55. Godfrey (1986) page 81 under Subspecies. Number (10) *B. c. taverneri* Delacour. R. S. Palmer, 1976 as above, did not recognize it but made one mention of "some so-called *taverneri*" under the Lesser Canada Goose *Branta canadensis parvipes*.
56. Taverner to Brooks, 26 July 1933, CMN.
57. Leon Cole to Taverner, 6 April 1932, CMN. They were first in touch with each other, over bird banding, in 1909. Cole was the first President of the American Bird Banding Association.
58. Taverner to Cole, 20 April 1932, CMN. In writing to Taverner at the National Museum Cole addressed him as "Dominion Ornithologist". Taverner was never given that title officially. However, from January 1937 Lynch agreed verbally that the title "Chief of Ornithology" could be used unofficially. See Taverner's handwritten "Zoological Record Book" 8 January 1937.
59. National Museum of Canada *Annual Report 1929* 17 (Bulletin Number 67) Ottawa, 1931. There were two boxes of postcards. Series A number 1 containing 50 cards, "Common Loon to Song Sparrows". Series A number 2 containing 60 cards, "Eared Grebe to Eastern Bluebird".
60. Collins to Taverner, 5 February 1929, CMN. Taverner to Brooks, 7 February 1929, CMN. On 4 February 1933 Taverner wrote to Brooks that the book seemed to be nearing completion, and that he had prepared a lot of additional line drawings for it.
61. C. B. Tidd to H. Lloyd, 25 March 1933, signed Sergeant C. B. Tidd, RCM Police, i/c Mayo Detatchment, CMN. The Taverner book he referred to was *Birds of Western Canada*.
62. Taverner to Collins, 3 October 1934, CMN.
63. Taverner to Laing, 3 July 1934, CMN.
64. P. A. Taverner *Birds of Canada*, page 294 under Wright's Flycatcher.
65. Brooks to Taverner, 27 August 1935, CMN.
66. National Museum of Canada, Bulletin Number 72. \$2.00 in cloth, \$1.50: paperback.
67. Joseph Grinnell, *The Condor* 37: 179-180 (1935). The very lifelike photo, which caught Taverner looking directly at the camera for once, rather than turning his head to one side as he usually did, was probably taken by a colleague at the 47th Annual Meeting of the AOU at Philadelphia in October 1929. The original photograph was sent by the taker and on the back of the original Taverner had written "received January 7, 1930". Martha Taverner kept the original until her death, when her son Karel Wiest had it. He kindly gave it to me when I interviewed him in Detroit only a few weeks before he died.
68. Witmer Stone *The Auk* 52: 333 (1935).
69. William L. Sclater *The Ibis* 5 Thirteenth Series: 688 (1935), British Ornithologists' Union, London.
70. Taverner to Ernest Ingersoll, 2 April 1935, CMN. Ingersoll wrote a natural history column in the *Montreal Family Herald and Weekly Star*.
71. Taverner was not the only one of the well-known members of the AOU of his generation who did not have any academic degrees.
72. J. A. Munro "The Necessity for Vermin Control on Bird Sanctuaries" *The Canadian Field-Naturalist* 37: 148-149; (1923); Editorial "Bird Sanctuaries" (same issue) pages 149-150. Letter to Editor on "Necessity for Vermin Control ..." from Wm. Rowan, January 1924, *The Canadian Field-Naturalist* 38: 30-33 (1924); A. Brooks letter to Editor, pages 33-34; Charles Townsend letter to Editor, page 35; Editorial "Control of Predatory Birds and Small Mammals" *The Canadian Field-Naturalist* 38: 35-36 (February 1924).
73. On Kerr see Chapter 9. Jack Miner's eldest son, Manly, acted as his father's secretary. Since he did not use a typewriter he had to write a mass of letters.
74. Manly F. Miner to Harkin, 15 February 1926, CMN, and signed by Manly.
75. Arthur Gibson, Dominion Entomologist. Taverner's position at this time was stated clearly in a letter to Harkin of 9 February 1926, CMN. Briefly he said that considerable destruction of hawks and owls was going on at a great many game farms in the winter "and there seems no way to stop it, except education."
76. E. R. Kerr to Harkin, 26 February 1926, CMN. The letter-head on the notepaper read: "The Jack Miner League". What Kerr meant when he wrote that Taverner and Saunders "may possibly make more headway among sportsmen and farmers" is not quite clear. Headway in what?
77. Jack Miner's philosophy (or religion) was strongly homocentric, one in which human terms were used to judge the actions of birds. Taverner's arguments were sound, but Miner did not accept the linguistic definition of "cannibal", only his own.
78. Taverner to Manly Miner, 22 February 1926, CMN. Arch-fiend was an echo from the Old Testament in English. It was ignorant to apply it to crows and other raptors.
79. Taverner to Manly Miner, 29 April 1926, CMN.
80. Manly Miner to Taverner, 30 April 1926, CMN.
81. Taverner to Manly Miner, late 1926, CMN.
82. Taverner to Manly Miner, 12 November 1926, CMN.
83. Hoyes Lloyd to Taverner, 15 December 1926, CMN. Lloyd made an interesting point in his letter — that the Miners did not have a permit allowing them to band birds for scientific purposes because they did not use authorized bands. Since that time legal band-

ing has increased substantially in Ontario and continues to flourish.

84. Taverner to Lloyd, 30 December 1925, CMN. Taverner obtained full returns of permit holders in Ontario for the year 1924. This showed that of 56 permit holders in the Province, 47 took no specimens at all and that the remaining 19 took 315 birds. Taverner commented that 315 birds killed for scientific purposes from widely scattered localities in the Province of Ontario in twelve months was a trifle. It was nothing in comparison with a dozen or more minor causes of bird mortality that were too trivial to cause remark: — "overhead wires, glass windows, railroad trains ... while the common cat undoubtedly kills several thousand times the number without any sign of uneasiness from our game departments, and forest fires destroy millions of birds without being considered."
85. William N. Kelly to Harkin, 6 March 1931, NAC; Lloyd to Taverner, 18 March 1931 with enclosures, CMN. Kelly was a consulting engineer.
86. Taverner to Lloyd, 20 March 1931, CMN.
87. Taverner to Harkin, 3 October 1931, in reply to Harkin's letter to Taverner of 1 September 1931, CMN.
88. H. J. Parham to Taverner, 3 November 1932, CMN.
89. Taverner to Parham, 11 November 1932, CMN.
90. Parham to Taverner, 24 November 1932, CMN.
91. Taverner to Parham, 15 December 1932, CMN. The term "local members" usually refers to "the local member of Parliament in a district".
92. The controversy over whether some collecting of bird specimens for scientific studies was necessary, or whether all collecting was quite unnecessary, as Parham argued, was still alive in the 1980s. An event occurred beside the Ottawa River in October 1982 when a small shore bird was "collected" in order that a group of birders could identify it without any doubt, thus solving the disagreement over what species it was. Information on the "collection" of this bird was published in the newsletter of the Toronto Field Naturalists of December 1982 (Number 352, pages 6–7). Readers were invited to write to the newsletter with their views, and also directly to Dr. Henri Ouellet, Curator of Birds, National Museum of Natural Sciences, Ottawa. Dr. Ouellet replied in detail in a subsequent issue. His main point was that "a small percentage of species or individuals in certain populations cannot be identified positively without a specimen; this applies currently ... because individual variation, even in the common species is not fully known and understood." Dr. Ouellet appended a list of 13 titles by ornithologists on various aspects of this contentious issue. (*Toronto Field Naturalist* Number 355, April 1983, pages 32-34.)
93. H. J. Parham *A Nature Lover in British Columbia*. H. F. Witherly Ltd., London 1937. Chapter 33 "Save the Birds" page 236, paragraphs 1 and 2. In paragraph 3 Parham wrote:

    "In southern British Columbia we have a few arid valleys and a narrow humid coastal strip in which are found, in very limited numbers, birds known to few, if any, other parts of Canada.

    "Some of these — in the Okanagan particularly — are the Canyon and Rock Wrens, Lazuli Bunting, Dickcissel, Brewer's Sparrow, Bobolink, Long-tailed Chat [Yellow-breasted Chat], Sage Thrasher and probably Sage Sparrow, Williamson's Sapsucker, Wilson's Phalarope and Burrowing Owl."
94. *The Ottawa Journal* 9 February 1938.
95. Parham to Taverner, 3 November 1932, paragraph 2, CMN.

## Chapter 16

1. Francis Kermode joined the British Columbia provincial museum, Victoria, in September 1890, and served as director from 1904 until he retired in 1940. Taverner and Kermode corresponded spasmodically from April 1914, and Taverner visited the provincial museum in 1922. As long as Taverner and Brooks were good friends there was no chance that Kermode and Taverner could be on good terms. There is no biography of Kermode, but there is some information on the 50 years of his service in the B.C. provincial museum in R. W. Campbell et al. *The Birds of British Columbia* Volume I, page 19. Published by the B. C. Museum, Victoria, 1990.
2. A provincial museum was founded at Edmonton, Alberta, in 1905 consisting of mounted birds and mammals, historical photographs and miscellaneous artifacts, with a staff of two or three unqualified civil servants. Since then the Alberta Museum has come a long way. Although not spacious for a provincial museum it is housed handsomely. The exhibits are attractively arranged.
3. For Horace Hedley Mitchell see Ron Borden "An Institution that Matters" *Liaison: Saskatchewan's Heritage Review* May 1986 page 5-6; Annual Reports of the Chief Game Guardian, Government of the Province of Saskatchewan, Department of Agriculture, Regina; Robert D. Symonds "Personal Recollections of some early Saskatchewan Naturalists" *Blue Jay* 24: 2-6 (1966). Taverner had known Mitchell since 1912.
4. Dr. H. M. Speechly. A country doctor who called himself a "humble roadside naturalist". But he was very much more than that. See Robert Symonds, "Personal Recollections" *Blue Jay* 24: 2-3 (1966). For the Manitoba Museum see A. M. Davidson, A. Simpson, H. G. Lawrence et al. *Natural History Society of Manitoba 21st Anniversary Bulletin 1920-1941*. Albion Press, Winnipeg, 1942, pages 56-59.
5. A. P. Harrold to Taverner, March 1929; Taverner to A. P. Harrold, March 1929, CMN.
6. Taverner to Cartwright, 4 April 1929, CMN.
7. Taverner to Cartwright, 25 April 1929, CMN.
8. Taverner to Speechly, 11 January 1937, CMN. One suggestion was to interest Angus Shortt in taking a course in museum management.
9. Taverner to Speechly, 26 December 1939, CMN.
10. Taverner to Speechly, 3 April 1940, CMN. This was a theme that Taverner continued to reiterate until the last months of his life.
11. Snyder heard the second of these talks, and wrote to Taverner congratulating him and thanking him for sending him a copy of it, which he was glad to have on file. The ideas were sound and beautifully expressed (Snyder to Taverner, 8 June 1934, CMN.). On the title page of the talk was printed: "Information for Radio Announcer":

"Mr. P. A. Taverner has been ornithologist to the National Museum of Canada since 1911. He is the author of several standard works on the Birds of Canada, and is a frequent contributor to journals devoted to natural history. He is a Fellow of the American Ornithologist's Union, and his researches and contributions have given him an enviable reputation among the ornithologists of the world."

12. Taverner to Snyder, 7 May 1923, CMN. When Snyder and party returned from the Lake Nipigon area, and the specimens collected had been prepared, Taverner was informed. He asked that they should be sent to the National Museum so that he could examine them carefully and compare them with specimens in the museum. In a four page letter he explained the difficulty in distinguishing between specimens of closely allied races such as in the Sharp-tailed Grouse, the juncos, and others. In this matter of extreme care he told Snyder "... I am regarded as more or less a crank because I will not vouch for what I cannot see, and do not believe in jumping at geological conclusions". Taverner to Snyder, 12 February 1924, CMN.
13. I am grateful to Ross D. James, Curator, Department of Ornithology, Royal Ontario Museum, for his information on this subject.
14. Snyder to Taverner, 2 February 1928, CMN.
15. Taverner to Snyder, 9 April 1931, CMN; Snyder to Taverner, 13 April 1931, CMN.
16. Taverner to Snyder, 18 March 1932. L. L. Snyder *The Hawks and Owls of Ontario*, CMN. Illustrations by T. M. Shortt. Published by Royal Ontario Museum of Zoology, University of Toronto Press 1932. Revised edition 1947. The introduction to this edition, page 16, concluded with these words. "It is a sad commentary to make, but shortly after the appearance of the original edition of this booklet [1932] , which was intended to aid in a better understanding of carnivorous birds, all protection was removed from all hawks and owls in the Province of Ontario. This was a retrograde step. By 1947 protection had been restored to 'Ospreys and eagles'.
17. Taverner to Snyder, 7 January; Snyder to Taverner, 2 February; Snyder to Taverner, 26 April 1935, CMN. Snyder described a new race of Sharp-tailed Grouse *Pedioecetes phasianellus campisylvicola* in 1935. University of Toronto Studies, Biological Series 4a.
18. Snyder to Taverner, 25 September 1939, CMN. Snyder's letter says more than I have written here about its contents.
19. Taverner to Snyder, 6 December 1939, CMN; Snyder to Taverner, 12 January 1940, CMN.
20. On Snyder's career see C. Long and J. C. Barlow "In Memoriam: Lester L. Snyder" *The Auk* 103: 809-811 (1986).
21. Baillie to Taverner, 13 January 1926, CMN. For a biography see Lise Anglin *Birder Extraordinaire: The Life and Legacy of James L. Baillie* (1904-1970) Toronto Ornithological Club and Long Point Bird Observatory, 1992.
22. Taverner to Baillie, 15 January 1926, CMN.
23. Taverner to Snyder, 7 February 1940, CMN.
24. Taverner to Snyder, 8 July 1940, CMN.
25. Taverner to Snyder, 28 September 1940, CMN. He explained that the war situation seemed to drain him of all inspiration and that he would have to call for help. "In Memoriam: James Henry Fleming" by L. L. Snyder, *The Auk* 58: 1-12 (1941).
26. Taverner to Snyder, 4 October 1940, CMN.
27. Taverner to Snyder, 15 March 1941, CMN.
28. Taverner to Snyder, 21 March 1941, CMN.
29. B. W. Cartwright to Taverner, 19 October 1928, CMN.
30. Taverner to B. W. Cartwright, 14 November 1928, CMN.
31. Cartwright to Taverner, 14 November 1928, CMN.
32. See Chapter 13 above, note 11.
33. See Marianne Gosztonyi Ainley "Henry Mousley and the Ornithology of Hatley and Montreal, 1910-1946". *Tchebec* 11: 113-134 (1981), especially pages 125-127.
34. For instance Taverner to Mousley, 3 July 1937, CMN. It starts revealingly "As you say we have certainly known each other long enough to drop formality." He then wrote about Mousley's "finding the Spotted Sandpiper assuming the responsible duties of family care ... ". Taverner then reported on his own experiences of finding a male Semipalmated Plover tending the nest more than the female. One incident worth mentioning is revealed in a letter from Taverner to F. H. Kennard of 29 February 1936, CMN. Apparently a train that he was riding from Boston was 1 1/2 hours late reaching Montreal. Taverner told Kennard: "Missed my Ottawa connection and had to stay there until 4 p.m. Went up to McGill and saw the Shearer-Wood Library, Wynne-Edwards and Mousley so the time was not wasted."
35. Taverner to Snyder, 10 December 1928, CMN, in reply to Snyder's letter of 8 December. Also see the 4-page account of the meeting of November 19-24 in P. A. Taverner to W. H. Collins, 13 December 1928, CMN.
36. Taverner to F. C. Lincoln, 6 July 1931, CMN. For details on Taverner's early banding see Chapter 3 and Chapter 4. Also Taverner's Note "Migration Studies by Bird Banding" in *The Canadian Field-Naturalist* 34: 158-159 (1920).
37. Lincoln to Taverner, 9 July 1931, CMN. For a study of banding in North America at this time see F. C. Lincoln "Bird Banding" in F. M. Chapman and T. S. Palmer *Fifty Years' Progress of American Ornithology 1883-1933*. The American Ornithologists" Union, Lancaster, Pa, 1933.
38. Taverner to Farley, 29 March 1932, CMN. This was a long letter explaining for what qualifications each member of the Committee had been appointed. Taverner appeared at pains to justify the fact that they were all Americans. He suggested that it might have been better if Fleming had been appointed in place of Oberholser as Fleming knew the Canadian distribution of birds better than any "on the other side", but he was not as well informed "to the south". Taverner did not think that there was any discrimination against Canadians in the U.S. though he knew there was strong discrimination against Americans "on this side". He then explained to Farley the handicaps that Canada faced in raising ornithologists with a deep understanding of ornithology, the main one being the lack of training facilities.
39. Palmer in *The Auk* 50: 64-74 (1933).
40. Palmer, *The Auk* 59: 71 (1933).

41. Palmer, *The Auk* 50: 71 (1933).
42. Taverner to Bishop, 14 December 1932, CMN.
43. Taverner to Brooks, 2 January 1934, CMN. For an explanation of the importance to Taverner of the idea of "camaraderie" at AOU meetings see note 50 below on the Appleton Club.
44. Taverner read his paper on 17 October. See *The Auk* 53: 59 (1936). Herbert Friedmann, Curator, Division of Birds, U.S. National Museum, Washington, came to Ottawa in the fall of 1934 to examine the collection of Red-tailed Hawks in the Canadian National Museum. He appears to have taken Taverner's work on the Red-tailed Hawk seriously — more than Witmer Stone did. Terry Shortt described Stone as "one of the most genial men I ever met … . But as a zoologist he was really a lightweight". Handwritten personal communication from Terence Michael Shortt to John Cranmer-Byng, May 1983.
45. Handwritten personal communication from Terence Michael Shortt to John Cranmer-Byng undated, but probably 1984.
46. Anonymous. *Auklet I* (1935) page 19. On the surface this appeared to be nothing more than a joke. But each issue of *The Auklet* was usually very topical, about things that happened at the last meeting, or since the last meeting, or about relations between certain members, and other matters. The reference to Taverner's "fragrant" act of plagiarism in relation to two particular books is likely to have had a playful alusion to tensions with Anderson. It was probably written by Taverner himself in cooperation with Hoyes Lloyd and one other. For a clue to its significance see this book, Appendix 3, item 21, Dr. R. M. Anderson to Dr. Charles Camsell.
47. Taverner to A. C. Bent, 15 November 1935, CMN.
48. Bent to Taverner, 20 November 1935, CMN.
49. Bent to Taverner, 23 November 1936, CMN.
50. Material on the Appleton Club as it was perceived by Taverner in his letters to close friends such as Taverner to Laing, 26 March 1934.
51. *The Auk* 56: 113 et seq. (1939) Five people spoke at the symposium on the individual versus the species in bird studies: Frances Herrick as seen in behaviour studies; G. K. Noble as seen in dominance; F. C. Lincoln in migration studies; Niko Tinbergen in the sociology of the Herring Gull; Margaret Nice in a study of the social life of the Song Sparrow. Nice said that Tinbergen was in America on a lecture tour and noted: "Dr. Tinbergen is a delightful man, so unassuming, yet so brilliant. I wished I could have had much more time to consult with him; a week would have been none too long." Margaret Morse Nice *Research is a Passion with Me*: The Autobiography of Margaret Morse Nice. *Edited by* Doris Huestis Speirs. The Margaret Nice Ornithological Club and Consolidated Amethyst Communications Inc. Toronto, 1979, page 197.
52. S. Charles Kendeigh *The Role of Environment in the Life of Birds* Ecological Monographs IV, July 1934, page 299-447.
53. Witmer Stone "Kendeigh on the Role of Environment in the Life of Birds" *The Auk* 51: 546 (1934).
54. Taverner to Bishop, 10 November 1936, CMN.
55. Taverner to Bishop, 23 September 1937, CMN.
56. Taverner to Brooks, 20 April 1938, CMN.
57. Herbert Friedmann "The Role of the A.O.U. in Ornithology Today" *The Auk* 53 (1938) 316 — one page only.
58. Taverner to Brooks, 5 May 1939, CMN.
59. Taverner to Rowan, 24 July 1939, CMN.
60. Taverner to Bishop, 20 July 1940, CMN.
61. Taverner, Annual Report for 1936-37 in Museum Bulletin number 89: 21-24. Also Taverner "An Ornithological Cross-Section of Manitoba on a line from the Arctic to the Transition Zone" (1937). Unpublished typescript. Taverner papers, Canadian Museum of Nature, Ottawa.
62. Ronnie W. Smith was a biology student. On his good and bad points see Taverner to Brooks, 10 November 1936, CMN.
63. On Randall see "Thomas E. Randall, nest finder supreme" by C. Stuart Houston, Marc E. Bechard and Philip H. Stepney, *Blue Jay* 42 (1984) December.
64. Taverner, Museum Bulletin 89: 21-24 (1936-37). They collected 428 bird skins and 50 sets of eggs etc.
65. Taverner, Museum Bulletin 89: 21-24 (1936-37). Also Taverner to Brooks, 26 September 1936, page 2, CMN.
66. Taverner, Museum Bulletin 89: 21-24 (1936-37).
67. Duck Mountain Provincial Park was established in 1961. Outside of the Park boundaries lies Duck Mountain Provincial Forest. In 1937 Shortt and Watkins were collecting within what became the Provincial Park, much of which is still untouched wilderness.
68. Angus Shortt to J. Cranmer-Byng, 25 February 1986. Shortt took up bird study and painting seriously in 1931 until 1935 when he was appointed Artist-Technician at the new Manitoba Museum. Here work included taxidermy, the arrangement of exhibits and paintings. In 1938 Shortt completed the field work for Taverner which he had started the previous year, proceeding from Dauphin to Riding Mountain. In January 1939 Shortt obtained a position with Ducks Unlimited which he held for 34 years. This opened up the field of waterfowl painting to him, and subsequently to an outstanding career as an artist-ornithologist.
69. Anecdotes from Shortt's 4-page typed resumé made from his field notes of 1937.
70. From same, page 4.
71. I was fortunate to be able to speak with Martha's son, Karel Wiest, shortly before his death. Also Peggy Wiest (formerly Ferguson) who married Karel in 1935, and her son, Corwin Ferguson, with whom I had several interviews in person and on the telephone. Several former piano students of Martha Taverner were very helpful: Ann Whitmore (ne Collins), Stuart Jenness, Barbara Lowe (subsequently Mrs. Reynolds), Karin Porsild (subsequently Mrs. Lumsden) and Jean York, formerly a pupil of Martha's at the Ligget School in Detroit.
72. What was happening to properties in the Beaumaris locality in the 1930s was strikingly similar to what happened in many parts of Muskoka in the 1970s and 1980s.
73. Taverner to Bishop, 6 October 1936, CMN.
74. Paul Larose letter to author, 28 August 1983, CMN. Ann Whitmore, conversation with author, 6 August 1983, remembered them being arranged in a pretty pewter bowl.

75. For example Erling Porsild in the Mackenzie region.
76. Taverner to Bishop, 7 July 1937, CMN.
77. Taverner to Brooks, 20 April 1937, CMN.
78. Taverner to Munro, 3 August 1937, CMN. *Lewisia columbinia*, perennial, colours from white to purplish rose.
79. Taverner to Munro, fall 1937, CMN.
80. Corwin Ferguson, conversation with author, 14 January 1984.
81. Taverner deliberately mixed the terms "lame duck" and "weak back" and coined a new phrase "a lame back".
82. Taverner to Laing, 1 May 1941, CMN.
83. Stuart E. Jenness conversation with author, 2 May 1984. For Martha's music teaching in Detroit see Chapter 13.
84. Barbara Reynolds conversation with author, 2 July 1984, and subsequent occasions.
85. Stuart Jenness conversation with author, 2 May 1984.
86. Taverner to Laing, 2 December 1938, CMN.
87. Barbara Reynolds, conversation with author, 2 July 1984, and in 1990.
88. Paul Larose, letter to author, 17 August 1983. Sunday evening trios were usually performed by: Martha Taverner — piano; Paul Larose — cello; Willie Amtmann — violin.
89. Karel Wiest, conversation with author, 13 and 14 January 1984.
90. Barbara Reynolds, "Birds and Music", a brief account of 45 Leonard Avenue, drawn mostly from her personal experience. One typewritten copy was given by the author to the present owners of 45 Leonard Avenue, and one copy to me in 1984 when I started writing about the building of the house. I am very grateful to Mrs. Barbara Reynolds for this copy.
91. F. M. Mowat "Notes on the Birds of Emma Lake, Saskatchewan" *The Canadian Field-Naturalist* 61: 105-115 (1947). Also F. A. Banfield "Notes on Saskatchewan Mammals" *The Canadian Field-Naturalist* 55: 117-123 (1941). Frank Banfield had just finished first year biology at the University of Toronto in the summer of 1938. In 1939 he turned over from ornithology as his main interest to mammalogy because, he said, there were too many student ornithologists about. Banfield, letter to author 15 January 1987.
92. Roger Tory Peterson *A Field Guide to the Birds. Giving field marks of all species found in Eastern North America.* Text and illustrations in color and black and white. Boston and New York, Houghton Mifflin Company, 1934. Price $2.75.
93. P. A. Taverner in *The Canadian Field-Naturalist* 49: 62 (1935). In his review he did not say anything condescending although he was reviewing the first book of a young author. He saw the innovativeness of the work, and gave it full credit, and in doing so foresaw the importance of the book for the future.
94. Taverner to Brooks, 30 November 1938, CMN.
95. P. A. Taverner *Canadian Land Birds; A Pocket Field Guide*. Illustrated by Allan Brooks, F. C. Hennessey and P. A. Taverner. Toronto 1939. 113 coloured plates, many drawings in black-and-white; small 8 volumes $2.50.
96. *A Field Guide to the Birds*. Giving Field Marks of All Species Found East of the Rockies. By Roger Tory Peterson. Revised and Enlarged. Boston 1939. Illustrated $2.75. Reviewed by Frank M. Chapman in *Bird-Lore* (1939) page 177.
97. P. A. Taverner *Canadian Water Birds; Game Birds; Birds of Prey: A Pocket Field Guide*. Illustrated by Allan Brooks, F. C. Hennessey and P. A. Taverner. Toronto, 1939. The Musson Book Company Ltd. pages 293; 100 plates in four colours, many drawings in back-and-white; small 8 volumes $2.50.
98. Frank M. Chapman in *Bird-Lore* (1940) page 57. For a note on Hennessey's style in bird illustrations see Chapter 10.
99. Taverner to Chapman, 28 February 1940. Taverner had received six pages of notes and sketches on hawk outlines from Louis Fuertes when he was preparing his figures of hawks for *Birds of Western Canada*. See Chapter 12, pages 267-268.
100. Robert C. Murphy in *Bird-Lore* 42: 198-199 (1940). Under Taverner's name on the title page are the words "Chief of the Ornithological Division, National Museum of Canada", hence Murphy's allusion to Taverner being "to all effects the official ornithologist of the Dominion of Canada". Taverner's Pocket Guides were published at a low point in the 20th century. If they had been published a few years earlier they might have stood a chance of making their mark before the war began to make its effects felt. If Taverner had lived five or more years after the war ended, instead of barely two, the book sales might have picked up sufficiently to give a revised edition of each a chance to take hold. But by extremely bad luck the sales of his volumes were not sufficient to justify a second edition when he died in May 1947. "Biographical notes" — meaning a bird's "life history".
101. For detailed information see Morris Zaslow *Reading the Rocks* (see chapter 5 note 1) 378-380, with organization chart.
102. Taverner to F. C. Lynch, 7 February 1938, CMN, giving information on the manuscript and presenting a copy; memorandum from John McLeish, Head, Mines and Geology Branch, to Charles Camsell, Deputy Minister, Department of Mines and Resources, 4 October 1938; Taverner to Brooks, 9 February 1938, CMN. For a note on McLeish's career see Chapter 17 below, note 41.
103. Snyder to Taverner, 30 July 1940, CMN.
104. Taverner to Snyder, 10 April 1941, CMN. It seems that Snyder and Shortt were determined that the ROM should support Kortright and his book, and that it should be published as soon as possible.
105. Snyder to Taverner, 19 April 1941, CMN. "Money talks" is a telling phrase, just as "shortage of money" (at the National Museum) said "no".
106. Taverner to Snyder, 29 April 1941, CMN. His manuscript was close to being sent for publication twice but each time the financial approval did not arrive in time for that year, and the process had to be gone through again another time. Government red tape and procrastination prevented its publication.
107. Earl Godfrey kindly discussed the manuscript of Taverner's "Practical Manual" with me at the Canadian Museum of Nature when I was doing research there in 1984. He said that when he first read Taverner's ms. in 1947 he felt that it was outdated. By that date it certainly was.

108. P. A. Taverner "Variation in the American Goshawk" *The Condor* 42: 157-160 (1940).
109. Taverner's arguments for accepting a recognizable strain of Goshawk on Vancouver Island and the Queen Charlotte Islands as different from *Accipiter gentilis* of the continental area are set out on page 159 of his paper.
110. P. A. Taverner "The Distribution and Migration of the Hudsonian Curlew" *The Wilson Bulletin* 54: 3-11 (1942). The current name for the species which Taverner was studying is *Numenius phaeopus* — Whimbrel.
111. Taverner to Fleming, 25 September 1929, ROM.
112. P. A. Taverner "The Distribution" (see note 101), page 4.
113. P. A. Taverner "Canadian Races of the Great Horned Owls". *The Auk* 59: 234-245 (1942). Although there were no illustrations in this paper, readers could see coloured illustrations of an Arctic and a Dusky subspecies of Great Horned Owl by Allan Brooks posed close to each other on the limb of a tree in winter. From P. A. Taverner's *Birds of Canada* (1934) plate opposite page 258.
114. Information in letter from Taverner to Laing, 1 May 1941, CMN.
115. W. Earl Godfrey *The Birds of Canada*. Colour Illustrations by John A. Crosby. Line Drawings by S. D. MacDonald. National Museum of Canada Bulletin Number 203. Ottawa 1966. A second edition, revised by Godfrey, was published by the museum in 1986.

## Chapter 17

1. See letters from Taverner to: Laing, 10 May 1938; Brooks, 15 and 30 November 1938; and 23 July 1940; to Laing, 29 May 1942, CMN.
2. Austin Loomer Rand, 1905-1982. Born Wolfville, Nova Scotia, showed unusual talent as a naturalist under the guidance of Robie W. Tufts. Receiving a B.Sc. from Acadia University he was awarded a Ph.D. at Cornell University. Started taking over the ornithological collection at the Canadian National Museum as an Assistant Zoologist in March 1942. For an account of his career as an ornithologist/mammologist see Melvin A. Traylor, Dean Amadon, and W. Earl Godfrey "In Memoriam: Austin L. Rand" *The Auk* 101: 600-602 (1984); W. Earl Godfrey "A Tribute to Austin Loomer Rand, 1905-1982" *The Canadian Field-Naturalist* 102: 564-571 (1988). For information that Rand started taking over in March 1942 see letter Taverner to Laing, 29 May 1942, CMN.
3. Taverner to Bishop, 20 July 1940, CMN.
4. Letter P. A. Taverner to *The Canadian Field-Naturalist* 56: 126 (1942).
5. Taverner to Laing, 29 May 1942, CMN.
6. A. L. Rand "*Larus kumlieni* and its Allies" *The Canadian Field-Naturalist* 56: 123-126 (1942). For Taverner's early work from 1916 on the *kumlieni* see Chapter 7. By way of contrast for work done in the 1980s on the subject the reader is referred to the paper by Richard R. Snell "Status of Larus Gulls at Home Bay, Baffin Island" *Colonial Waterbirds* 12: 12-23 (1989). For further recent studies see Ron Pittaway "Subspecies of the Iceland Gull" *Ontario Birds* 10: 24-26 (April 1992).
7. W. B. Timm to Taverner, 24 June 1942; Harrison F. Lewis to Taverner, 19 September 1942; Alexander Wetmore to Taverner, 21 September 1942, CMN.
8. P. A. Taverner, unpublished, "Biographical Outline of Percy Algernon Taverner". [Compiled by himself, 1942.] 4 page Taverner papers, Canadian Museum of Nature.
9. Snyder to Taverner, 4 April 1944, CMN. W. E. Saunders died on 28 June 1943.
10. Taverner to Snyder, 13 April 1944, CMN.
11. My own experience in writing this account of Taverner's life is an example of someone starting a new interest immediately on retirement from their profession.
12. Taverner to Snyder, 17 December 1940, CMN. P. A. Taverner letter to *The Auk* 60: 306-307 (1943). Also David Lack "Habitat Selection and Speciation in Birds" *British Birds* 34: 80-84 (1940).
13. Ernst Mayr *Systematics and the Origin of Species: From the Viewpoint of a Zoologist*. Columbia University Press 1942.
14. P. A. Taverner "Canadian Status of the Long-tailed Chickadee" *The Auk* 57: 536-541 (1940). P. A. Taverner "The Red-winged Blackbirds of the Canadian Prairie Provinces" *The Condor* 41: 244-246 (1939).
15. Ernst Mayr to Taverner, 8 March 1943, CMN. Written on paper with letter-head of the American Museum of Natural History.
16. Taverner to Mayr, 13 March 1943, CMN.
17. Richard Beddoes to Taverner, 7 September 1941, CMN.
18. Taverner to Beddoes, 23 September 1941, CMN.
19. Louise de Kiriline Lawrence *The Lovely and the Wild* (New York, 1968) pages 38-39. Here Lawrence explained why she first wrote to Taverner: "What impressed me was Mr. Taverner's talent of turning what could have been a dry annotated list of birds, a description of species by species, what they look like, what they do, what they eat into a tale of astonishing fascination and vividness. And this I told him."
20. Louise de Kiriline Lawrence to Taverner, 9 June 1940, CMN.
21. Taverner to Louise Lawrence, 21 June 1940.
22. Louise Lawrence to Taverner, 7 November 1940.
23. Taverner *Birds of Canada*, page 330. His description of the Veery's song is a personal statement of how he reacted to it. He wrote that a Veery had "a tone like the jingling of a golden chain".
24. Louise Lawrence to Taverner, 7 November 1940, last paragraph.
25. Louise Lawrence to Taverner, 9 December 1941.
26. W. E. Ricker and C. H. D. Clarke "The birds of the vicinity of Lake Nipissing, Ontario". *Contributions to the Royal Ontario Museum of Zoology* 16: 1-25 (1939).
27. Taverner to Louise Lawrence, 3 June 1941.
28. Louise Lawrence to Taverner, 26 February 1942.
29. Taverner to Louise Lawrence, 30 June 1942. Endorsed by Louise Lawrence in ink: "I think this one of the most beautiful letters I have ever had the privilege to receive".
30. Louise Lawrence to Taverner, 25 January 1946, CMN. Percy's last letter to Louise was written on 22 January 1946 in which he said, among other things, "... you have been a very brave woman. If any small

support I have given you in your introduction to a bird world has been of any value to you I [one word illegible] that I have been at least some value to the world". In her reply of 25 January 1946 Louise Lawrence picked on a special trait of Taverner's when she wrote: "I remember when I first began to study BIRDS OF CANADA I never realized that this was only a part of your monumental work which surely will live on as long as there is a human being left to profit by it; and your humility in the estimation of its value is only further testimony of its and your own greatness." The words "your *humility* in the estimation of its value" are especially perceptive.

31. Taverner to Mrs. Gladys Scott, 31 July 1939. The Scotts had first invited Taverner's mother and sister to stay on Blue Sea Lake in July 1917. As a result the Taverners bought a plot there and eventually Taverner designed and built a cottage. (See Chapter 7.)
32. Taverner to Graham Rowley, on service in England, 1 May 1941.
33. Personal communication Corwin Ferguson to J. Cranmer-Byng at Highland Park, Detroit 14 January 1984, and in 1986. Also by telephone on 19 December 1988.
34. Marte (nee Wiest) Kent personal communication with J. Cranmer-Byng by telephone April 1984.
35. Taverner to Fleming, 23 January 1940, ROM. By contrast Anderson wrote very differently about Harlan Smith. He had no sympathy for him.
36. See Chapter 12 note 42.
37. Taverner to Brooks, 4 March 1931; Taverner to Ernest Ingersoll 26 August 1931; Taverner to Rowan, 6 October 1931, CMN.
38. Taverner to Lynch, 13 July 1935, CMN. The financial slump had begun to hit the economy by 1929 and affected the museum severely between 1931 through 1936. (See Chapter 14 above, notes 84-87.)
39. The Mines and Geology Branch comprised three main divisions, one of which was the National Museum of Canada under the administrative control of Lynch. How the change of organization affected Taverner individually is not possible to estimate.
40. Taverner to Lynch, 7 February 1938, CMN.
41. McLeish, memorandum to Camsell, 4 October 1938, NAC. The process of government approval at that level was desperately slow, and it took nearly a year before a decision was made. If it had been agreed to publish the manuscript *early* in 1938 the money for its printing might have been made available. John McLeish was born in Toronto in 1874, B.A. Unversity of Toronto 1894 with 4 years' mathematics and physics, and 2 years in chemistry and mineralogy. Joined Mines Section, Geological Survey, 1897. Retired as Director of Mines and Geology branch, Department of Mines, in 1941 after nearly 45 years' service. McLeish played an important part in building up the mining industry in Canada.
42. This was *The Ducks, Geese and Swans of North America* by Francis H. Kortright. (See Chapter 16 above, notes 118 and 119.)
43. Taverner to Frank Farley, 8 February 1944, CMN. By the word "now", Taverner probably wished to indicate "in time of war", i.e., something to keep his mind occupied.
44. Taverner to Laing, 8 March 1947, CMN.
45. See note 68 below.
46. See *The Canadian Field-Naturalist* 59: 42 (1945), left column.
47. *The Canadian Field-Naturalist* 60: 59-60 (1946).
48. Taverner to Snyder, 13 April 1944, CMN.
49. Manly Miner to Taverner, 6 March 1946, CMN.
50. Henri Ouellet "Profile of a pioneer: P. A. TAVERNER" *American Birds* 41: 20-26 (Spring 1987). Illustrated with 10 photographs, and 3 drawings by Taverner of four details of a Whimbrel's plumage.
51. Taverner to Baillie, 9 March 1945, CMN. One of the people using the Taverner collection at the "old" Quebec Provincial Museum in 1957 was a college student by the name of Henri Ouellet. At that time Mrs. Bernadette Langelier, curator of the bird collection, allowed Ouellet to study the scientific material in the Taverner collection. He was much impressed by journals such as *The Auk* and *Wilson Bulletin*, and above all by Ridgway's multi-volumed *Birds of North and Middle America*. He was also impressed by the scope of Taverner's contribution to Canadian ornithology. Taverner intended that his library should be of special use to students of ornithology. It would have given him great pleasure to have known that Henri Ouellet obtained a Ph.D. degree, joined the National Museum of Canada as assistant curator in 1970, and in 1976, when Earl Godfrey retired, Henri Ouellet took charge of the ornithological department. (Dr. Henri Ouellet, letter to author, August 1992.) Ouellet later became Chief Zoologist, and "retired" in January 1994, but remains a Research Associate and Researcher Emeritus with the Canadian Museum of Nature.
52. Taverner to Angus Mowat, 3 January 1947, CMN.
53. Angus Mowat to Taverner, 6 January 1947, CMN.
54. Taverner to W. B. Timm, 22 April 1946, CMN.
55. Earl Godfrey in conversation with J. Cranmer-Byng, 1984.
56. On Jean York see note 71 below.
57. H. Deichmann to Taverner, 28 January 1947, ROM.
58. Taverner to H. Deichmann, 6 February 1947, ROM.
59. Calais is just inside the State of Maine across the St. Croix River from New Brunswick. It is situated at the west point of the Bay of Fundy, and is not far from Saint John.
60. Since Deichmann had a copy of Taverner's *Birds of Canada* he would use it to distinguish between the female Common and female Red-breasted Mergansers. See *Field Marks* (page 111) where Taverner stated "It is doubtful whether females [of the Common Merganser] may be distinguished in life, with certainty, from the Red-breasted Merganser. The darker brown of the head, its sharp ending on the neck, and the white throat are suggestive but not determinative characters". Under *Field Marks* of the Red-breasted Merganser (page 112) he stated: "The paler red of the head, its gradual blending into the lower neck and body-colour, and the lack of decided white throat patch are suggestive but not determinative." The illustration of the female Red-breasted Merganser by Brooks (plate 12) was not very distinctive. The Common Merganser was not illustrated. It was not until Godfrey's *The Birds of Canada* in 1966, with illustrations by John Crosby, that the reader had

a chance to examine distinctive illustrations of both females on the same page (see plate 14 on page 97).

61. Taverner to H. Deichmann, 26 February 1947, ROM.
62. H. Deichmann to Taverner, 9 March 1947, ROM.
63. Though Taverner died, his influence continued. Deichmann expanded his note taking; obtained a B.Sc. (Forestry) University of New Brunswick 1957, then worked in interior of Newfoundland. From 1963-present: Did graduate work in wildlife management at Acadia University, Nova Scotia. 1970-1971. Worked in New Brunswick in Provincial Parks, active in naturalists clubs, Chief Naturalist Fundy National Park (1973). Active with New Brunswick Federation of Naturalists. In 1981 he returned to Newfoundland to Terra Nova National Park, as Resource Management Advisor; subsequently Park Ecologist, Gros Morne National Park, recently retired. (Henrik Deichmann, letters to author 20 October 1983 — January 1993.)
64. Marjorie Brooks to Taverner, 16 January 1946, CMN.
65. Erling Porsild and Taverner had known each other since 1928. Relations between the two men in the 1940s, and Erling's warm feelings towards Percy, can be gathered from Porsild's tribute to Taverner in the *Proceedings of the Royal Society of Canada*, Series 3, Volume 41: 133-135 (1947) especially the last paragraph on page 134.
66. On Mrs. Sharman see Chapter 1. Several times Mrs. Sharman and Taverner just missed meeting each other during his adult life. It was as though they were fated not to meet.
67. Why Austin L. Rand resigned in July 1947 just after he had been promoted to Acting Chief of the Biological Division, on the retirement of R. M. Anderson, is not entirely clear. What Taverner wrote is probably as close as we can come to sizing up the situation. Rand did, in fact, resign and moved to Chicago, where he was curator from 1947-1955, and Chief Curator of Zoology from 1955-1970. Hugh L. Keenlyside was Deputy Minister of Mines and Resources, and Commissioner of the NWT from 1947-1950. See also W. Earl Godfrey. 1988. "A tribute to Austin Loomer Rand, 1905-1982. *The Canadian Field-Naturalist* 102(3): 564-567; Francis R. Cook and W. Earl Godfrey 1988. "Canadian bibliography of Austin L. Rand". *The Canadian Field-Naturalist* 102(3); 567-571.
68. The Practical Manual was not published during his lifetime and has remained unpublished until the present. When Taverner died he did not leave the manuscript of the Manual to the National Museum; instead Martha inherited it. Some time after she had returned to Detroit she gave the manuscript to Karin Porsild and Harry Lumsden who had recently married. Harry Lumsden showed me the manuscript in the 1980s and we discussed the problem of preserving its sections adequately. In 1992 Mr. and Mrs. Lumsden donated the Practical Manual of Waterbirds etc. to the Royal Ontario Museum. (Harry Lumsden, conversation with author, August 1992.) It is now in the process of being studied, given a finding aid, and preserved in acid free envelopes, as a first step towards its permanent preservation.
69. Taverner to Laing, 8 March 1947, PABC. I am grateful to Richard Mackie for bringing this letter to my notice. Taverner's original is in the H. M. Laing Papers of the Provincial Archives of British Columbia. In his appreciation of Taverner J. A. Munro wrote: "I met Percy first at Okanagan Landing, British Columbia, in July 1916; I saw him last in February, 1947, when he entertained a few old friends at his home in Ottawa. He seemed, on that last occasion, in good health. He talked well; he was charming and gracious as always. So I shall remember him." J. A. Munro "P. A. Taverner, An Appreciation 1875-1947" *The Canadian Field-Naturalist* 62: 34-35 (1948).
70. Percy Taverner died on 9 May 1947.
71. Jean York in conversation with the author 16 September 1984, relaying what she had heard from Martha about Percy Taverner's last moments. Jean York (nee McKay) studied music under Martha Wiest at the Ligget School in Detroit before Martha married Percy in 1930. Later Jean married the Ottawa gynaecologist, Dr. Geoffrey York. When her husband died suddenly, Martha was kind to Jean and her young son. In 1984, when I began to collect personal reminiscences about Taverner's life, I had several conversations with Jean York, then a woman of 77. One of the questions I asked her was about Taverner's death. She told me clearly that Martha told her that at the time of his death Percy had one tune in his mind which kept on recurring. But because he was unable to finish it he asked Martha to finish the tune for him, which she did. Soon after he had the full tune in his mind Percy Taverner died.

# **Index to Text** (Pages 1-196)

Comprehensive for people, institutions, societies and species (by both common and scientific names), but selective for most pertinent or frequent localities.

## About the Author: John L. Cranmer-Byng

John Cranmer-Byng (Jack to his family and friends) was born on 18 March 1919 in the east anglian part of England in rich farming country where birds were plentiful. He started observing birds at an early age, encouraged by his parents who gave him a three volume book *The Birds of the British Isles and their Eggs* with many coloured illustrations. This was for his birthday in 1927. From this time onwards John became a keen birdwatcher, an interest that has remained with him until this day.

In 1937 John went to Cambridge University to major in history. In May 1940, just as John finished writing his final exams, the Second World War exploded in full force, and students were transformed into military recruits. John enlisted in September 1940 as a private in the infantry. For the next six years he was completely out of civilian life, though not before he was awarded a B.A. (Hons).

John became a parachutist with the British 1st Airborne Division, and by 1944 he had risen to the rank of Captain. In September 1944 1st Airborne made a parachute landing in Holland near the town of Arnhem. The ensuing battle of Arnhem was intense and heavy in casualties. At the end John and his platoon were ferried across the Rhine to safety by a detachment of Canadian Engineers, an experience he will never forget. Shortly afterwards John was awarded the Military Cross.

The Second World War ended in September 1945, but John was not demobilized until 1946. He wanted to return to Cambridge and start studying again. While waiting for an opportunity, he applied for a Treasury Fellowship in the Chinese language, which he received in 1951. This enabled him to learn Chinese at Cambridge University.

In 1954 John went to Singapore where he employed a Chinese scholar under whom to study. It was at this time that he met his wife, Margaret, who was on her way to a position at the British Embassy in Bangkok, Thailand. They were married in Singapore in 1955.

John's wish for a university post was fulfilled, though not in England. He was appointed Lecturer in History at the University of Hong Kong, starting in September 1956. In 1962 he was promoted to Senior Lecturer. He taught European, Southeast Asian and Chinese history to undergraduate and graduate students. The Hong Kong years, 1956-1964, were busy and productive. John had several articles published on Chinese customs and institutions and on China's relations with Britain and the British East India Company. His knowledge of written Chinese helped him to research the Chinese perspective when he was writing his book *An Embassy to China*, containing the journal kept by Lord Macartney of his embassy to China in 1793, edited with an introduction, notes and appendices (page 420). This was published in 1962 by Longmans Green, England.

The Hong Kong years were busy on the family front too. During this time John and Margaret's three children were born. For recreation there was swimming in the sea, boat trips to islands, and an abundance of exciting birds to observe, both resident and migrants. John was an active member of the Hong Kong Bird Watching Society, and with them he was able to visit the many scenic areas of Hong Kong Island and the New Territories.

In July 1964, John was appointed Associate Professor at the University of Toronto to teach the history of Modern China. He became a full Professor with tenure in 1966. Courses taught included Modern China, 1600-1911 and Modern China in Revolution. In 1975 John became an Associate of the University of Toronto's Institute for Environmental Studies and took an active part in its affairs.

By the 1970s, John's enjoyment of birdwatching had broadened into a deeper interest in environmental issues such as habitat loss and the need for citizen participation in conserving natural areas. Since settling in Toronto he had seen many attractive natural places destroyed by the growth of Metropolitan Toronto. Rather than accept this as inevitable he became involved, together with the Toronto Field Naturalists, in making studies of local ravines, with recommendations on how to preserve them. In 1979, John was awarded the Federation of Ontario Naturalists' Conservation Award for that year for his sustained conservation initiative. Eight ravine surveys had been completed by that date.

Recognizing the need for specialized information on the ecology of urban natural areas, John, together with W. A. Andrews of the Faculty of Education, University of Toronto, joined to produce a handbook designed to help concerned citizens, as well as students, planners and politicians. This was *Urban Natural Areas: Ecology and Preservation* and was published in 1981 by the Institute for Environmental Studies as Environmental Monograph Number 2. Contributors included faculty members from many departments of the University such as Forestry, Geography, Zoology, Botany and Urban Planning, and an Environmental Lawyer.

More recently John worked with Martin K. McNicholl to co-edit *Ornithology in Ontario*, a book of 11 chapters by 24 contributors. This is a history of ornithology in the province, and includes chapters on archaeology, egg collecting, naturalist clubs and museums, as well as biographies of the pioneers in the field. It was published by Hawk Owl Publishing in 1994 as Special Publication Number 1 of the Ontario Field Ornithologists.

John retired from the University of Toronto in 1984 and was named Professor Emeritus. Retirement years have been devoted partly to the writing of Percy Taverner's biography, but they have also provided opportunity for travel. John and Margaret have now visited and enjoyed all the provinces of Canada.

## Editor's Acknowledgments

*The Canadian Field-Naturalist* has long had a history of special issues, the most recent previous to this being 109(3), July-September 1995, on the history of the exploration of the vascular flora of Canada, St. Pierre et Miquelon, and Greenland by James S. Pringle, published in cooperation with the Missouri Botanical Gardens, St. Louis, Missouri. The earliest was *Birds of Saskatchewan* by Hedley Mitchell in 38(6), May 1924, followed by *Canada North of Fifty-six Degrees: The Land of Long Summer Days* by E. M. Kindle 42(3), March 1928. Before and subsequently, other long articles were published from time to time but split and run in parts over consecutive issues instead of as a single topic issue. In recent decades notable special issues have been *A Guide to the Geology of the Ottawa District* by Alice E. Wilson in 70(1), January-March 1956, and (although not quite filling a complete issue) *A Guide to the Geology of the Gatineau-Lievre District* by Donald D. Hogarth in 76(1), January-March 1966. Later, three issues were dedicated to the Peregrine Falcon (and other raptors) 84(3), July-September 1970; 90(3), July-September 1976; and 104(2), April-June 1990, with financial support from the Canadian Wildlife Service, and a number of issues have been devoted largely to COSEWIC status reports for fish and marine mammals (usually edited and abridged) 1984-1994 though special financial support made available through the Department of Fisheries and Oceans and Environment Canada (Canadian Wildlife Service).

Publication of *A Life with Birds* as the latest Special Issue of *The Canadian Field-Naturalist* was initiated in response to an enquiry to The Ottawa Field-Naturalists' Club in 1995 by Ross James of the Royal Ontario Museum on behalf of the author. Ross also read the entire manuscript and brought the common names and scientific nomenclature up to date. W. Earl Godfrey and Henri Ouellet, both currently Researcher Emeritus at the Canadian Museum of Nature, and former successors to Taverner's position as ornithologist at the National Museum of Canada and Canadian Museum of Nature (1946-1976 and 1977-1993, respectively), also read all or portions of the original manuscript. Daniel F. Brunton contributed to the history of the Ottawa Field-Naturalists' Club. All three, together with Ross James, strongly supported this publication as did the publications committee and the council of the Ottawa Field-Naturalists' Club.

It has been my great pleasure and delight to work closely with John and Margaret Cranmer-Byng on the final editing and additions to the manuscript. Special thanks are due to Bonnie Livingstone Publications, for quickly and characteristically cheerfully arranging formal permission from the Canadian Museum of Nature for use of photographs in the collections of that institution, to Arch Stewart and Mireille Boudreau of the Canadian Museum of Nature library for answering bibliographic questions and for searching prints and data on them, respectively, always with enthusiasm and encouragement. Diane Martineau at the National Archives, Researcher Services Advisor, was similarly helpful as was Ann Sutherland of the Metro Toronto Reference Library. Special thanks are due Murray Edwards for permission to use the Taverner family photograph on page 7. Mark Vajcner University Archives, University of Alberta arranged for permission to use Soper photograph. Bill Cody helped in many ways to smooth the process throughout.

Francis R. Cook

A Life with Birds:
Percy A. Taverner, Canadian Ornithologist, 1875-1947

JOHN L. CRANMER-BYNG

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THE CANADIAN FIELD-NATURALIST Volume 110, Number 1 1996

A Life with Birds: Percy A. Taverner, Canadian Ornithologist, 1875-1947

JOHN L. CRANMER-BYNG



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Second Class Mail Registration No. 0527 – Return Postage Guaranteed. Date of this issue: April-June 1996 (June 1996).

### Back Numbers and Index

Most back numbers of this journal and its predecessors, *Transactions of The Ottawa Field-Naturalists' Club,* 1879-1886, and *The Ottawa Naturalist*, 1887-1919, and *Transactions of The Ottawa Field-Naturalists' Club and The Ottawa Naturalist – Index* compiled by John M. Gillett, may be purchased from the Business Manager.


**Cover**: Portion of the shoreline of Loyst Lake in Lennox and Addington County, Ontario, showing open rock barrens dominated by Common Juniper, *Juniperus communis*, and other shrubs including Bear Oak, *Quercus ilicifolia*. Photograph taken in July 1994 by V. R. Brownell. See article on plants at their northern limits in the granite barrens area that includes this locality by V. R. Brownell, C. S. Blaney, and P. M. Catling, pages 255–259.

The Canadian Field-Naturalist

Volume 110, Number 2 April–June 1996

# Recent Discoveries of Southern Vascular Plants at their Northern Limits in the Granite Barrens Area of Lennox and Addington County, Ontario

VIVIAN R. BROWNELL[1], C. SEAN BLANEY[2], and PAUL M. CATLING[1]

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Brownell, Vivian R., C. Sean Blaney, and Paul M. Catling. 1996. Recent discoveries of southern vascular plants at their northern limits in the granite barrens area of Lennox and Addington County, Ontario. Canadian Field-Naturalist 110(2): 255–259.

*Aristida dichotoma* (Poverty-grass), *Eleocharis engelmannii* (Englemann's Spike-rush), *Lindernia dubia* var. *anagallidea* (False Pimpernel), *Quercus ilicifolia* (Bear Oak), and *Rotala ramosior* (Branched Toothcup) are disjunct in the granite barrens of Lennox and Addington County. *Quercus ilicifolia* occurs in dry, open scrub communities developed on shallow soil over granite rock, and is an addition to the native shrub flora of Canada. The other taxa were found within the annual fluctuation zone of open, biotite-rich metasedimentary rock shorelines, and were previously known from the Carolinian zone of extreme southwestern Ontario. The nearest populations of *Quercus ilicifolia* and *Aristida dichotoma* are about 230 km to the southeast in Oneida County, New York State. The closest extant populations of the other species range from 490-575 km to the southeast in New York State and/or 370 km to the southwest in the Carolinian region of southwestern Ontario. The disjunctions are attributed to a combination of warmer microclimate due to the abundant open rock surfaces and restricted specialized habitats of open and strongly fluctuating shorelines in the barrens region. All of the species are rare in both Ontario and Canada and are also rare in many of the adjacent states.

Key Words: *Aristida dichotoma*, Poverty-grass, *Eleocharis engelmannii*, Englemann's Spike-rush, *Lindernia dubia* var. *anagallidea*, False Pimpernel, *Quercus ilicifolia*, Bear Oak, *Rotala ramosior*, Branched Toothcup, Ontario, disjunction, rare species, phytogeography.

Many vascular plants present in southwestern Ontario are absent from the central portion of the north shore of Lake Ontario, but present near the far eastern end of the lake (Cody 1982; Brownell et al. 1994). Others are unique in Ontario to the eastern Lake Ontario region. Some of these are found on the limestones, sands and clays of the Lake Ontario Lowlands (Beschel 1970), while others occur slightly further east on the Frontenac Axis, a region of rugged granitic and metamorphic rocks connecting the main portion of the Canadian Shield and the Adirondack Highlands. Among the well-known examples of these southern species at their northern limit on the Frontenac Axis of the Kingston region are Pitch Pine (*Pinus rigida* Miller), Shining Sumac (*Rhus copallina* L.), Stemless Yellow Violet (*Viola rotundifolia* Michx.), and Deerberry (*Vaccinium stamineum* L.). Recent field studies of the Lennox and Addington barrens, a region further to the west, but still within the Canadian Shield north of Prince Edward County (Figure 1), have revealed another concentration of southern species.

The Lennox and Addington rock barrens is a region characterized by numerous lakes, wetlands and more-

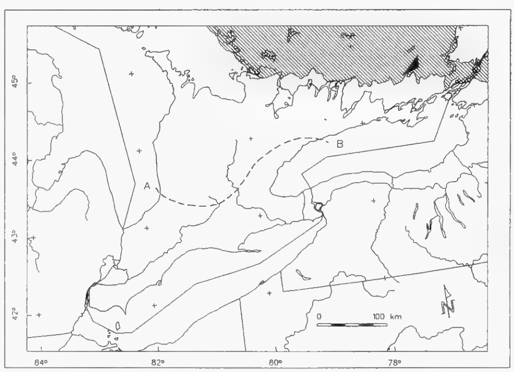


FIGURE 1. Southern Ontario showing the northern limit of the Carolinian zone (dashed line A-B, most recent interpretation - see Allen et al.1990), the Canadian Shield region (diagonal hatching, provided by E. Haber) and the approximate region of the Lennox and Addington barrens (shaded triangle).

or-less open oak woodland as well as open rock barrens. The open areas of exposed rock, often extending as steep slopes right to the shorelines, are a distinctive feature, and the prominence of exposed rock is clear in satellite images. The area is the easternmost extensive section of granitic rock barrens in southern Ontario. A roughly triangular area, the Lennox and Addington barrens (Figure 1), extends from West Sheffield Lake in Hungerford Township of Hastings County northeast to Mountain Grove including the top half of Sheffield Township in Lennox and Addington County, and the southern third of Kennebec Township of Frontenac County, thence southeast to Fifth Depot Lake including the northwestern corner of Hinchinbrooke Township and the southern portion of Olden Township in Frontenac County, then west across the north side of Beaver Lake north of Tamworth to West Sheffield Lake (Figure 1). This area is mapped, although not precisely, by Chapman and Putnam (1972, 1984), as "bare rock ridges and shallow till", and is not connected to the Kaladar rock barrens area to the north and west. Here we report on and discuss disjunct occurrences of southern species in the Lennox and Addington barrens.

## Methods

Specimens documenting the following reports are preserved in the Agriculture Canada herbarium in Ottawa (DAO) with some duplicates at the University of Michigan (MICH). Detailed location data required for research purposes may be requested from the Ontario Ministry of Natural Resources offices, Natural Heritage Information Centre, or herbarium curators.

## Significant Southern Disjunctions

### *Aristida dichotoma* Michx., Poverty-grass

Approximately 35 plants occurred along the shore of Puzzle Lake (*Catling & Brownell 20569; Catling and Brownell s.n.* [sine numero = without number] *12 August 1994* and at least 200 along the shore of Sheffield Long Lake (*Catling & Brownell s.n.* 8 October 1994; *Catling and Brownell 20530).* The only species of *Aristida* previously reported from eastern Ontario is the provincially rare *A. longispica* Poir. (Three-awn), which is locally abundant in the sandy pannes of Presqu'ile Provincial Park (*Catling & Brownell s.n., DAO*). Poverty-grass is very similar, but differs in having the central segment of the lemma awn spirally twisted instead of bent, and in having longer lower glumes 6–8 mm long. Although documented from two railway yards in southwestern Ontario (Catling et al. 1978; Dore and McNeill 1980), *A. dichotoma* was not admitted to the Ontario rare plant atlas (Argus et al. 1982–1987) or to the list of rare vascular plants of Canada (Argus and Pryer 1990), because it was not known from a natural plant community. However, the recently discovered disjunct sites in the Lennox and Addington barrens are in natural communities strongly dominated by native species and including many rare and restricted native species (see below and V. R. Brownell 1995. A biological inventory and evaluation of the Puzzle Lake Area of Natural and Scientific Interest. Draft report prepared for the Ontario Ministry of Natural Resources, Tweed District, Tweed, Ontario. 98 pages + 3 maps). They are the only known native occurrences of this species in Canada. Associates along the open, biotite-rich metasedimentary rock shoreline (Figure 2) near the high water mark included *Bulbostylis capillaris* (L.) C. B. Clark and *Agrostis scabra* Willd. The plants occurred in the very shallow soil in small rock crevices. The nearest potentially natural site is apparently about 230 km southeast in the vicinity of Syracuse, New York on open, sandy soil (Catling and Brownell, personal observations; Paine 1865). This Atlantic coastal plain species is documented from only one location in Michigan (Voss 1972), but is known from 29 counties in the southeastern portion of New York State (New York Flora Association 1990).

### *Eleocharis engelmannii* Steud., Engelmann's Spike-rush

This species was first reported from Ontario in 1987 from four locations in Essex and Norfolk Counties (Ball 1987). Currently, two sites are known in Essex County and five sites have been documented in Norfolk County (D. A. Sutherland 1995, personal communication). These closest populations of *E. engelmannii* occur about 370 km to the southwest of the Lennox and Addington County barrens. All of the sites have small populations, usually with less than 30 plants. On the shore of Puzzle Lake (*Catling & Catling 20566)*, it occurred with *Lindernia dubia* var. *anagallidea* in cracks on flat shoreline rocks below the high water level. This population included 34 plants within an area of 50 $m^2$. Other occurrences in southwestern Ontario have been on wet, open, sandy or muddy shores.

In the United States, *E. engelmannii* is a widespread species, but is rare in several states, including adjacent Michigan, Ohio and New York (Ball 1987). It is also rare in the provinces of Manitoba, Saskatchewan and Alberta, and is considered imperiled in Canada (Argus and Pryer 1990). In New York State, only one extant population, consisting of about 30 to 40 plants, is known (S. Young 1995, personal communication). This site is in Suffolk County approximately 575 km southeast of the Lennox and Addington County barrens.

### *Lindernia dubia* (L.) Pennell var. *anagallidea* (Michx.) Cooperrider, False Pimpernel

This variety, known previously from southern British Columbia (Straley et al. 1985) and, recently, from the Carolinian region of southwestern Ontario

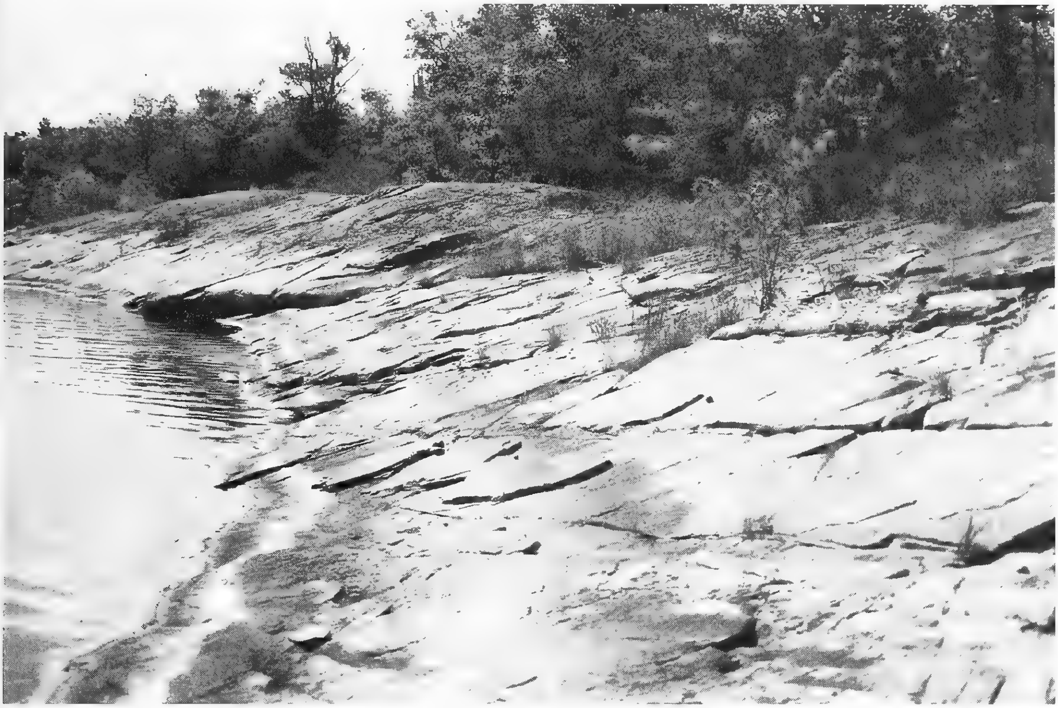

FIGURE 2. Open rocky shoreline habitat of *Aristida dichotoma* and *Quercus ilicifolia* in Lennox and Addington County, Ontario. Photograph taken in August 1994 by V. R. Brownell.

(*Oldham 4507*, TRTE; Heagy 1993; Sutherland 1987; *Sutherland 9351* (DAO); Goodban et al. 1994; and specimen at UWO, Oldham, personal communication), is considered rare in Canada (Argus and Pryer 1990). On the open shores of Puzzle Lake (*Catling & Catling 20567, 20599a; Catling & Brownell s.n. 12 August 1994*), it occurred in rock cracks that were submerged during the early part of the year. Two populations were discovered each including approximately 50 plants. Associates included *Eleocharis engelmannii* and *Rotala ramosior*.

This is a widespread taxon in the United States, ranging from New Hampshire to Washington, and southward from Florida to California (Pennell 1935, map 31). In Michigan it is considered rare. The New York Natural Heritage Program does not track this taxon despite its relatively restricted historical occurrence in only six counties (S. Young, personal communication, 1995; New York Flora Association 1990). It is distinguished from *Lindernia dubia* var. *dubia* by its long peduncles, relatively short leaves and open flowers. With the largest leaves 10 mm long or less and pedicel/bract ratios exceeding 1.6, as well as brownish-yellow seeds ca. 0.3 mm long, the plants from Puzzle Lake are the most extreme in the direction of var. *anagallidea* yet collected in eastern Canada. The rank of variety has been considered appropriate due to intergradation with *L. dubia* in the upper Mississippi valley (Cooperider and McCready 1975; Cooperider 1976). The nearest locations appear to be those in southwestern Ontario and those in Ulster County, New York State (New York Flora Association 1990) which are both about 370 km away from the newly discovered disjunct stations.

### *Quercus ilicifolia* Wang., Bear Oak

The discovery of this shrub at several locations within an area of approximately 8 km$^2$ in the Lennox and Addington barrens, represents an addition to the flora of Canada. Locations include Little Gull Lake (*Brownell & Catling 20492; Catling & Brownell s.n. 12 August 1994*), Loyst Lake (*Blaney s.n. 1, 2 July 1994; Brownell & Catling 20602*), Puzzle Lake (*Catling & Brownell s.n. 12 August 1994*), Sheffield Long Lake (*Catling & Brownell 20518*) and Wheeler Lake (*Brownell, Larson & Blaney s.n. 23 September 1994*). The total population size within this area is estimated to range from 800 to 1000 plants, with individual sites, separated by a few hundred metres to a few kilometres, having a maximum of 300 plants. The plants occur in dry, open scrub communities developed on very shallow soil over biotite granite rock, and are most often on or near to shores. The most frequent associate is Common Juniper (*Juniperus communis* L.).

Bear Oak is largely confined in North America to the Atlantic coastal plain and northern Appalachian region (Little 1977). The reports of *Q. ilicifolia* from "Lake Huron" (Gibson and Macoun 1875a, b) are evidently based on a 1874 collection by J. Gibson (MTMG). The specimen is considered to have an incorrect label (Ambrose et al. 1987). The nearest stations to the Lennox and Addington barrens are the remnants of the Rome pine plains about 230 km to the south at the eastern end of Oneida Lake in New York State (Paine 1865; C. J. Sheviak, personal communication), which are also disjunct from the main range.

### *Rotala ramosior* (L.) Koehne, Branched Toothcup

This plant is critically imperiled in Canada (Argus and Pryer 1990). It occurs in southern British Columbia and was found for the first time in Ontario in Norfolk County in 1984 (Oldham and Sutherland 1987). It is unlikely to be extant in southwestern Ontario, however, since the two areas have been converted into a corn field and pastureland (D. A. Sutherland, personal communication, 1995). At Puzzle Lake (*Catling & Brownell* 20599) and Sheffield Long Lake (*Catling & Brownell s.n.* 2 August 1994, October 1994), it occurred in rock crevices along the open shore near the water line and had been under water for at least several weeks during the spring and early summer. Associates included *Cladium mariscoides* (Muhlenb.) Torrey, *Eleocharis elliptica* Kunth and *Lindernia dubia* var. *anagallidea*. Thirty-three plants were seen along the shore of Sheffield Long Lake and over 50 occurred along the shore of Puzzle Lake.

The nearest extant site is about 490 km to the southeast in Putnam County, New York State (New York Flora Association 1990; S. Young, personal communication, 1995). It is ranked as imperiled in New York with seven extant sites known, and it is considered rare in Michigan.

## Discussion

The prominence of rock in this area undoubtedly contributes to a warmer microclimate than is experienced by surrounding forested regions. The lack of forest over much of the landscape probably also contributes to the relatively broad annual fluctuations in water level. Three species, *Eleocharis engelmannii*, *Lindernia dubia* var. *anagallidea* and *Rotala ramosior* appear to often occur in similar habitats and sometimes in association with each other in northeastern North America. These habitats are usually open, periodically wet sand. The openness of the landscape, presence of numerous open shorelines, and low nutrient substrates are habitat conditions not represented to the same degree in surrounding regions in Ontario. Limestone and glacial till substrates exist a few kilometres to the south and extend to the Lake Ontario shore and around the west side of the lake. Granite barrens are much more restricted further to the east on the Frontenac Axis (Chapman and Putnam 1972, 1984). Consequently, we attribute the disjunctions to a combination of warmer microclimate due to the abundant open rock surfaces and restricted specialized habitats of open and strongly fluctuating low nutrient shorelines in the barrens region. Possibly these species were more widespread during the middle Holocene warm and dry interval 8–4 thousand years ago which was followed by temperature decrease over the past four thousand years and southward shifts of southern forest elements (Anderson 1995). The nearest populations of *Quercus ilicifolia* and *Aristida dichotoma* are about 230 km to the southeast in Oneida County, New York State. The closest extant populations of the other species range from 490–575 km to the southeast in New York State and/or 370 km to the southwest in the Carolinian region of southwestern Ontario .

## Acknowledgments

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# Additions and Range Extensions to the Vascular Plant Flora of the Northwest Territories, Canada

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Cody, William J. 1996. Additions and range extensions to the vascular plant flora of the Northwest Territories, Canada. Canadian Field-Naturalist 110(2): 260–270.

Seventeen taxa are reported new to the flora of the Northwest Territories north of latitude 60°N, plus nine new to the District of Keewatin north of latitude 60°N (excluding the islands of southern Hudson Bay and James Bay), one to the District of Mackenzie, and 29 range extensions within the District of Keewatin, 12 range extensions within the District of Mackenzie, two deletions from the Northwest Territories and 12 comments on distribution since previous publications on the flora.

Key Words: Additions, range extensions, vascular plants, Northwest Territories.

Since the publication of *Illustrated Flora of the Canadian Arctic Archipelago* (Porsild 1964) and *Vascular Plants of Continental Northwest Territories, Canada* (Porsild and Cody 1980) continued field and taxonomic studies have revealed the presence of additional taxa in the Territories that were unknown to the authors at the time of publication. These include both introduced and native taxa. The preparation of a manuscript on the rare plants of the Northwest Territories (McJannet et al. 1995) spurred the examination of a mass of material that had accumulated since the publication of Porsild and Cody (1980). The present paper reports these taxa and also a series of range extensions of taxa that were known from the Territories but are now known to be much more widespread. In addition, several taxa which have been reported elsewhere, two of which were unfortunately missed by Porsild and Cody (1980), are reported here in order to bring these additional taxa together in one place.

## Synoptic list by Northwest Territories status

Taxa new to the Northwest Territories north of latitude 60°N (17)

*Alisma plantago-aquatica* var. *americana*
*Allium fistulosum*
*Arabis holboellii* var. *secunda*
    *lyrata*
    *pinetorum*
*Botrychium simplex*
    *spathalatum*
*Carex prairea*
*Danthonia spicata*
*Descurainia incisa* ssp. *incisa*
*Epilobium hornemanii*
*Isoetes lacustris*
*Poa pseudoabbreviata*
*Potamogeton obtusifolius*
*Senecio ogotorukensis*
*Veronica longifolia*
*Viola selkirkii*

Taxa new to the District of Keewatin north of latitude 60°N (9)

*Botrychium lunaria*
*Cerastium regelii*
*Deschampsia brevifolia*
*Draba norvegica*
*Gymnocarpium jessoense* ssp. *parvulum*
*Minuartia dawsonensis*
*Moneses uniflora*
*Utricularia minor*
*Viola renifolia* var. *brainerdii*

Taxon new to the District of Mackenzie (1)

*Deschampsia paramushirensis*

Range extensions of taxa in the District of Keewatin north of latitude 60°N (29)

*Astragalus eucosmus*
*Betula nana* ssp. *exilis*
*Calamagrostis purpurascens*
*Caltha palustris* var. *arctica*
*Chrysanthemum integrifolium*
*Draba crassifolia*
*Dupontia fisheri* ssp. *psilosantha*
*Equisetum fluviatile*
*Erigeron elatus*
*Galium trifidum*
*Harrimanella hypnoides*
*Juncus arcticus*
*Luzula wahlenbergii*
*Lycopodium clavatum* var. *monostachyon*
    *complanatum*
*Pedicularis hirsuta*
*Petasites frigidus* ssp. *frigidus*
    *frigidus* ssp. *palmatus*
    *sagittatus*
*Pyrola minor*
*Ranunculus gmelinii*
    *pallasii*
    *sabinei*

*Ribes glandulosum*
*Rubus idaeus*
*Triglochin maritimum*
*Utricularia intermedia*
*Viburnum edule*
*Woodsia alpina*

Range extensions of taxa in the District of Mackenzie (12)
*Arabis arenicola*
*Botrychium lunaria*
*Draba lactea*
*Oxytropis viscida*
*Papaver mcconnellii*
*Phegopteris connectilis*
*Salix petiolaris*
*Sibbaldia procumbens*
*Silene acaulis* ssp. *acaulis* f. *albiflora*
*Solidago graminifolia* var. *major*
*Subularia aquatica* ssp. *americana*
*Viola epipsila* ssp. *repens*
Deletions of taxa from the flora of the Northwest Territories (2)
*Danthonia intermedia*
*Saxifraga tenuis*

Comments on taxa in the flora of the Northwest Territories (12)
*Adoxa moschatellina*
*Braya glabella* ssp. *purpurascens*
*Descurainea sophioides*
*Erigeron alpiniformis*
*Monarda fistulosa* ssp. *menthifolia*
*Pleuropogon sabinii*
*Podistera macounii*
*Potamogeton subsibiricus*
*Ranunculus cymbalaria*
*Rorippa crystallina* (*Nasturtium crystallinum*)
*Salix raupii*
*sphenophylla*

## Annotated list by family

### LYCOPODIACEAE

*Lycopodium clavatum* L. var. *monostachyon* Hook. & Grev., Common Club-moss — KEEWATIN: protected south slopes and ridges, in willow thickets, very local, small colonies, Griffin Lake, 61°17'N 98°47'W, *K.L. Reading s.n.*, July-August 1990 (DAO).*

Previously known in southern mainland District of Keewatin from a single locality (Porsild and Cody 1980; Cody and Britton 1989).

*Lycopodium complanatum* L., Ground Cedar — KEEWATIN: protected south slopes sand ridges, in willow thickets, very local, small colonies, Griffin Lake, 61°17'N 98°47'W, *K.L. Reading s.n.*, July-August 1990 (DAO).

Previously known in southern mainland District of Keewatin from only two localities (Porsild and Cody 1980).

*Herbarium acronym (Holmgren et al. 1990)

### ISOETACEAE

*Isoetes lacustris* L. (*I. macrospora* Durieu), Quillwort — MACKENZIE: Travaillant Lake, 67°41'N 131°48'W, *Strange & MacDonell s.n.*, 30 July 1985 (CAN) (determined by D. M. Britton).

This site is about 3100 km northwest of sites in northwestern Ontario known to Cody and Britton (1989); there are, however, intermediate sites in northwestern Saskatchewan: Stony Rapids, Fond du Lac River, 59°16'N 105°46'W, *G. Argus 487-63*, 30 July 1963 (CAN) (determined by D. M. Britton; this latter site was included in the rare plants of Saskatchewan (Maher et al. 1979) and it is also known from Hidden Bay of Wollaston Lake, Collins Bay of Wollaston Lake and northeast of Cantara Lake on the south shore of Lake Athabasca (all determined by D. F. Brunton-V. L. Harms (personal communication, 1995). New to the Northwest Territories north of 60°N latitude.

### EQUISETACEAE

*Equisetum fluviatile* L., Water Horsetail — KEEWATIN: solitary small tundra rock pond, abundant population, east of South Bay of Griffin Lake, 61°17'N 98°47'W, *K.L. Reading s.n.*, 5 August 1990 (DAO).

Known from only one other locality in the south of mainland District of Keewatin (Porsild and Cody 1980).

### OPHIOGLOSSACEAE

*Botrychium lunaria* (L.) Sw., Moonwort — KEEWATIN: alders and open white spruce/tamarack parkland, sandy-wet, east side of South Bay of Griffin Lake, 61°17'N 98°47'W, *K. L. Reading s.n.*, 5 August 1990 (DAO); wet *Arctostaphylos* ground cover in open tamarack parkland, local, common where found, west of South Henik Lake, 61°22'N 97°53'W, *K.L. Reading s.n.*, 6 July 1990. MACKENZIE: along portage trail, Bloody Falls, Coppermine River, photo by K. J. Hebden, 2 August 1980 (DAO).

The District of Keewatin sites are intermediate between a site at Churchill, Manitoba and Fort Smith in southern District of Mackenzie; new to mainland District of Keewatin; the District of Mackenzie site represents a northeastward extension of the known range of some 550 km from the south shore of Great Bear Lake (Porsild and Cody 1980; Cody and Britton 1989).

*Botrychium simplex* E. Hitchc., Simple Grape-fern — MACKENZIE: Great Bear Lake, Atacho Point, 66°N 121°30'W, *A.E. & R.T. Porsild 3468A*, 24 August 1928 (CAN) (determined by W. H. Wagner).

This is a northward extension of the known range of some 900 km from a site near the North Saskatchwan River in central Alberta (Cody and

Britton 1989; Packer 1983). New to the flora of the District of Mackenzie and the Northwest Territories north of 60°N latitude.

*Botrychium spathulatum* W.H. Wagner — MACKENZIE: Nahanni National Park, near base of "Beehive Mountain", 61°33'N 125°23'W, *G. W. Scotter 24197*, 10 July 1977 (DAO).

This specimen which is a paratype of Wagner's new species (Wagner and Wagner 1990) is the only record yet known from the Northwest Territories.

### ASPIDIACEAE

*Gymnocarpium jessoense* (Koidz.) Koidz. ssp. *parvulum* Sarvela, Nahanni Oak-fern — KEEWATIN: very rare, one site only on a N-facing low scarp, Culleton Lake area, 61°20'N 97°40'W, *K. L. Reading s.n.*, late July 1991 (DAO).

New to mainland District of Keewatin; to the south it is rare in northern Manitoba; Harms et al. (1992) knew this species from 20 localities in northern Saskatchewan south to approximately 55°N latitude and considered it borderline vulnerable in that province.

*Phegopteris connectilis* (Michx.) Watt (*Dryopteris phegopteris* (L.) Chr. *Thelypteris phegopteris* (L.) Slosson), Long Beech Fern — MACKENZIE: drainage beds under boulder fields in shade of large willow and alder bushes, rare, vicinity of Daring Lake, 64°52'N 111°37'W, *McNair & O'Brien 2*, 11 August 1994 (DAO); not common, Eastern Great Slave Lake Region, Porter Lake, 61°42'N 108°02'W, *Ovenden & Rowe 240*, 6 July 1977 (DAO); common in "trickle irrigation" bouldery drainageway, same locality, *Ovenden & Rowe 683*, 13 August 1977 (DAO).

This rare species was first reported from the Northwest Territories by Cody and Porsild (1968) on the basis of a collection from the Canada Tungsten Mine area adjacent to the Yukon Territory border. Cody et al. (1979) reported a second locality in the Nahanni National Park area of the southern Mackenzie Mountains. The Porter Lake collections cited above were plotted by Cody and Britton (1989) but no reference was made to the locality and habitat in the text. The Daring Lake locality which is the most northeasterly yet reported in the District of Mackenzie lies some 350 km north northwest of Porter Lake. To the south it has been collected at the east end of Lake Athabaska in Saskatchewan (Porsild and Cody 1980; Cody and Britton 1989) and seven additional localities mapped by Harms et al. (1992*) who considered it vulnerable in that province.

*Woodsia alpina* (Bolton) S.F. Gray, Alpine Woodsia — KEEWATIN: "Pebble Beach" Lake, 62°22'N 97°30'W, south of Yathkyed Lake, *K. Reading 85-5*, 28 June 1985 (DAO).

This is the third collection of this taxon from central mainland District of Keewatin (Porsild and Cody 1980). Korol (1992) reported it from coastal District of Keewatin in the vicinity of Rankin Inlet.

### POTAMOGETONACEAE

*Potamogeton obtusifolius* Mert. & Koch. (*P. porsildiorum* sensu Porsild and Cody (1980) pro parte), Blunt-leaved Pondweed — MACKENZIE: in shallow water, Mile 12.75 Mackenzie River-Yellowknife Hwy., *Thieret & Reich 7858*, 20 July 1961 (DAO); in small lake, Mile 38.3S Mackenzie River-Yellowknife Hwy., *Thieret & Reich 8359*, 2 August 1961 (DAO); in shallow water at disturbed edge of small pool, Mile 45.5S Mackenzie River-Yellowknife Hwy., *Thieret & Reich 7947*, 23 July 1961 (DAO); KEEWATIN: west of Bissett Lake, *K. L. Reading s.n.*, 31 August 1982 (photo DAO).

This is a more or less circumboreal species which in North America occurs from Newfoundland to British Columbia and southward. It is new to flora of Northwest Territories.

*Potamogeton subsibiricus* Hagstr. (*P. porsildiorum* Fern.) — MACKENZIE: Anderson River Delta, *T.W. Barry 411*, 18 August 1961 (DAO, CAN); brackish lagoon, Liverpool Bay, Nicholson Island, 70°N 129°W, *A.E. & R.T. Porsild 28/6*, 15-16 August 1927 (CAN); shallow stagnant pool in muskeg, Mackenzie River Delta, East Branch, 68°40-55'N, *A.E. Porsild 7242*, 11 August 1934 (CAN); in shallow sluggish stream, Mackenzie Delta, East Branch, Hansen's Creek, approx. 68°10'N, *A.E. Porsild 7364A*, 2 October 1934 (CAN); Aubry Lake, 67°20'N 126°25'W, *Riewe & Marsh 237*, 18 July 1976 (CAN).

This taxon is known in the District of Mackenzie only in the extreme northwest. Specimens collected by Thieret and Reich north of Yellowknife mapped by Porsild and Cody (1980) as *P. porsildiorum* have been revised to *P. obtusifolius* (see above).

### SCHEUCHZERIACEAE

*Triglochin maritimum* L., Arrow-grass — KEEWATIN: rare, single colony in wet hollow in tundra, "Nocamp Lake", 62°21'N 97°26'W, south of Yathkyed Lake, *K. Reading 85-37 s.n.*, 9 July 1985 (DAO); rare, very local, Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, 1991 (DAO).

These are the third and fourth collections of this taxon in southern mainland District of Keewatin (Porsild and Cody 1980).

### ALISMATACEAE

*Alisma plantago-aquatica* L. var. *americana* J. A. Schultes (*A. triviale* Pursh), Water-plantain — MACKENZIE: in mud, shallow pools near waterfalls, Hanging Ice (Tethul) River junction with

*See Document Cited Section

Talston River, 60°34'N 112°13'W, *M. Anions s.n.*, 9 August 1980 (DAO).

Cody (1956) reported this taxon from Fort Fitzgerald, in northern Alberta as a northern extension of the known range northward from Chipewyan on Lake Athabaska (*C.C. Loan 205* (DAO)); the specimen cited above is a further extension of the known range of some 90 km; new to the flora of the Northwest Territories.

**POACEAE (GRAMINEAE)**

*Calamagrostis purpurascens* R.Br., Purple Reedgrass — KEEWATIN: 10 km NW of town on moist tundra, Rankin Inlet, 62°49'N 92°05'W, *J. B. Korol 176*, 21 July 1988 (DAO).

This collection was reported by Korol (1992) as *C. deschampsioides* Trin., a species which is much more delicate and has a lax, pyramidal panicle. *Calamagrostis purpurascens* was known to Porsild and Cody (1980) from a single collection in southwestern District of Keewatin some 300 km SSE of Rankin Inlet.

*Danthonia spicata* (L.) Beauv. ex Roemer & J.A. Schultes (*D. intermedia* sensu Scotter & Cody 1974), Poverty Oat Grass.

Scotter and Cody (1974) reported *D. intermedia* as new to the District of Mackenzie on the basis of a collection by Scotter in Nahanni National Park along trails near hotsprings, 61°15'N 124°03'W, (*12285A*, 26 June 1970 (DAO)). This and nine additional specimens from the park were revised to *D. spicata* by Darbyshire (Darbyshire and Cayouette 1989), thus deleting *D. intermedia* from the flora of Continental Northwest Territories and replacing it with *D. spicata.*

*Deschampsia brevifolia* R.Br., Hairgrass — KEEWATIN: Rasmussen Lowlands, slope with low hummocks, on the west side of Iglulik Lake where the Inglis River drains out, 68°49'18.5"N 92°26'04"W, *V. Johnston 63A1b*, 1 July 1994 (DAO).

This is an extension of the known range south-southwest of some 100 km from a site plotted by Porsild and Cody (1980) on the southeastern side of Boothia Peninsula. It is the first record for mainland District of Keewatin.

*Deschampsia paramushirensis* Honda (*D. pumila* (Trin.) Ostenf.) — MACKENZIE: Mackenzie River Delta, Richards Island, collected on a dry lakebed, lake drained in 1978, *L. Ovenden 2257*, 8-15 August 1985.

Porsild and Cody (1980) mapped the distribution of this species (sub *D. pumila*) in North America as known to them. McLachlan et al. (1988) give the range and habitat and discuss it (sub *D. paramushirensis*) in relation to *D. caespitosa*. The specimen cited above is intermediate between a site on the arctic coast of Alaska at about longitude 157°W and sites on the arctic islands of the District of Franklin and in central mainland District of Keewatin. It is the first known collection from the District of Mackenzie.

*Dupontia fisheri* R.Br. ssp. *psilosantha* (Rupr.) Hultén, Tundra Grass — KEEWATIN: Rasmussen Lowlands, low, flat, wet, numerous small ponds, polygonal ground approx. 10 km E of Inglis Bay, 68°36'55"N 93°14'28"W, *V. Johnston 5A1*, 17 June 1994 (DAO).

This collection represents a northwestward extension of the known range of some 500 km from a site at Rankin Inlet plotted by Porsild and Cody (1980). To the west it is known from the southeastern end of Victoria Island in District of Franklin and from the vicinity of Bathurst Inlet in northwestern District of Mackenzie.

*Pleuropogon sabinii* R.Br., Semaphore Grass

This species was first reported from mainland District of Keewatin by Cody et al. (1989) on the basis of a collection of George Scotter in the vicinity of Wager Bay. Korol (1992) extended the known range southward to Rankin Inlet.

*Poa pseudoabbreviata* Roshev. — MACKENZIE: dry graminoid tundra, Northern Richardson Mountains, 68°03'31"N 135°57'57"W, *Loewen & Staniforth 93-285A*, 12 July 1993 (DAO).

Cody et al. (1990) reported this species as new to the flora of Canada based on specimens collected by C. E. Kennedy in the British Moutains in Ivavvik (Northern Yukon) National Park and Cody (1994) has reported an additional collection from that area. The specimen cited above extends the known range southeastwards some 175 km to northwestern District of Mackenzie.

**CYPERACEAE**

*Carex prairea* Dewey, Prairie Sedge — MACKENZIE: in woods in wet bog, 3.3 mi. S and E along Mackenzie Hwy. (from Liard Ferry), 61°04'N 121°11'W, *N. A. Skoglund 708*, 11 June 1973 (determined by J. H. Hudson) (DAO).

According to the map in Packer (1983), this is an extension of the known range northward from central Alberta. New to the flora of the District of Mackenzie and the Northwest Territories. This species has also recently been reported new to the Yukon Territory on the basis of a collection by H. Raup in the extreme southeast (Cody 1994).

**JUNCACEAE**

*Juncus arcticus* Willd., Arctic Rush — KEEWATIN: Rasmussen Lowlands, low and flat with many ponds, some hummocks, some elevated dry areas, near Chantrey Inlet, 67°14'08.6"N 95°10'11.9"W, *V. Johnston 47B2*, 3 July 1994 (DAO).

This is a northward extension of the known range in mainland District of Keewatin of some

300 km from sites plotted by Porsild and Cody (1980).

*Luzula wahlenbergii* Rupr., Wahlenberg's Woodrush — KEEWATIN: Rasmussen Lowlands, hummocks mixed with rock rubble and scattered frost boils, east of the upper reaches of the Castor and Pollux river, 68°12'46"N 93°17'21"W, *V. Johnston 36A7*, 26 June 1994 (DAO); low and flat with many ponds, some hummocks and some elevated dry areas, near Chantrey Inlet, 67°47'08.6"N 95°10'11.9"W, *V. Johnston 47A4*, 3 July 1994 (DAO); wet hummocky plain with lots of frost-heaved rock, east side of the Paquet River, 68°12'N 93°16'W, *V. Johnston 440-2-3*, 5 August 1993 (DAO).

These collections, which are intermediate between a site on the Arctic Coast at the east end of the Queen Maud Gulf and a site on the southeast side of the Melville Peninsula, are the northern most yet found in the District of Keewatin.

### LILIACEAE

*Allium fistulosum* L., Welsh Onion — MACKENZIE: living plants collected by Gilles Patenaude and Joe Mackenzie on dry gravelly S-facing slope 20 miles SE of Rae-Edzo and 1 mile inland from Great Slave Lake in August 1989 and grown in a garden at Yellowknife by Patenaude. In June 1992 transplanted to Sooke, British Columbia where he took up residence.

Herbarium specimen (in seed) collected by Patenaude, 19 June 1994 and sent to Ottawa for determination and preservation (DAO); living plants sent to Ottawa September 1993 by Patenaude and grown in garden by Cody - specimen in flower, (*Cody 35605*, 23 June 1994 (DAO). On 27 October 1994 Patenaude advised me by phone that there were about 50 plants observed at the site southeast of Rae-Edso where the living plants were collected. The same day Joseph Mackenzie, a native employee of the Department of Renewable Resources at Rae-Edso, told me that this onion plant was growing at the site of old Fort Rae and that he also knew of additional sites on nearby islands. The suggestion was made that this onion had been introduced by members of a mission or by employees of the Hudson Bay Company. New to the flora of the Northwest Territories.

### SALICAEAE

*Salix petiolaris* J. E. Smith (*S. gracilis* Anders.), Meadow Willow — MACKENZIE: well-drained gravel, Mackenzie Delta wellsite Gulf-Mobil Siku E-21, 69°00'29"N 133°36'54"W, *D.W. Smith 48*, 11 August 1980 (DAO).

The above collection represents a northern extension of range of some 500 km from Norman Wells.

*Salix raupii* Argus, Raup's Willow

Argus (1986) reported this species as new to the Northwest Territories on the basis of specimens from southern Nahanni National Park and Fisherman Lake, District of MacKenzie. It was described by him (1974) on the basis of collections from adjacent to the Alaska Highway in northeastern British Columbia and has since also been found at Fern Lake (57°45'N 124°47'W) in British Columbia and at Nose Mountain (54°30'N 119°32'W) and Kakwa Falls (54°05'N 119°40'W) in western Alberta (Argus 1986). It should be searched for elsewhere in the region.

*Salix sphenophylla* Skvotsov, Wedge-leaf Willow — MACKENZIE: moist tundra, Cape Dalhousie, 70°13'N 129°40'W, *W.J. Cody 13129*, 31 July 1963 (DAO) (det. G.W. Argus).

This specimen was mapped and cited by Argus (1973) but unfortunately *S. sphenophylla* was overlooked by Porsild and Cody (1980).

### BETULACEAE

*Betula nana* L. ssp. *exilis* (Sukatsch.) Hultén (*B. glandulosa* sensu Porsild & Cody 1980 pro parte), Dwarf Birch — KEEWATIN: Rasmussen Lowlands, low and flat with many small ponds, near Chantrey Inlet, 67°14'08.6"N 95°10'11.9"W, *V. Johnston 47A5, 47A6*, 3 July 1994 (DAO).

This is a northward extension of the known range of some 300 km from sites plotted by Porsild and Cody (1980).

### CARYOPHYLLACEAE

*Cerastium regelii* Ostf. — KEEWATIN: wet soil with occasional drier tussock, Rasmussen Lowlands, approx. 4 km south of Dewline, 68°45'10"N 93°25'39"W, *V. Johnston 462-3-3*, 7 August 1993 (DAO).

New to mainland District of Keewatin. Porsild and Cody (1980) knew this species, which is common throughout the Canadian Arctic Archipelago, from only two sites on the Canadian mainland: Tuktoyaktuk and Melville peninsulas. The location cited here is south of the Boothia Peninsula. In addition to the Tuktoyaktuk Peninsula locality *C. regelii* is now also known from the Melville Hills region in northern District of Mackenzie (Cody et al. 1992).

*Minuartia dawsonensis* (Britt.) House, Rock Sandwort — KEEWATIN: Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, 1991 (DAO).

Not previously recorded from mainland District of Keewatin; to the west the nearest sites are at the east end of Great Slave Lake in District of Mackenzie, to the southwest, the north shore of Lake Athabaska in Saskatchewan, and to the south in the vicinity of Churchill, Manitoba (Porsild and Cody 1980). Argus (1966) also reported it from the Hasbala Lake area in extreme northeastern Saskatchewan (sub. *Arenaria stricta* ssp. *dawsonensis*).

*Silene acaulis* L. ssp. *acaulis* f. *albiflora* Hartz, Moss-Campion — MACKENZIE: near Burnside

River, 66°51'N 108°20'W, *G.W. Scotter 96603*, 7 July 1992 (DAO).

The type specimen of this white-flowered form was collected in Greenland. It is of rare occurrence across northern Canada.

### RANUNCULACEAE

*Caltha palustris* L. var. *arctica* (R.Br.) Huth., Marsh Marigold — KEEWATIN: Rasmussen Lowlands, low and flat with numerous small ephemeral ponds, approx. 5 km NW of mouth of Inglis River, 68°38'17.5"N 93°36'22.7"W, *V. Johnston 63A5*, 10 July 1994 (DAO).

This is the most northeasterly locality yet known in Canada. It has been found some 150 km to the south southwest in District of Keewatin and to the west on King William Island in District of Franklin (Porsild and Cody 1980).

*Ranunculus cymbalaria* Pursh, Northern Seaside Buttercup — KEEWATIN: Chesterfield Inlet, *Dutilly 6602W*, 16 août 1938 (QFA).

This record for mainland District of Keewatin which was reported by Blondeau and Cayouette (1987) was an extension of the known range of some 550 km northward from the vicinity of Churchill, Manitoba. It has since been reported by Korol (1992) from Rankin Inlet, about 60 km to the southwest.

*Ranunculus gmelinii* DC., Yellow Water Crowfoot — KEEWATIN: Rasmussen Lowlands, low and flat peat, approx. 5 km NW of the mouth of Inglis River, 68°38'17.5"N 93°36'22"W, *V. Johnston 63A6*, 10 July 1994 (DAO).

This collection represents a northward extension of the known range of some 500 km from sites in central District of Keewatin (Porsild and Cody 1980). To the west it is known from the southeastern end of Victoria Island in District of Franklin and Rankin Inlet in northwestern District of Mackenzie (Porsild and Cody 1980).

*Ranunculus pallasii* Schlecht., Pallas' Buttercup — KEEWATIN: Rusmussen Lowlands, low and flat with many ponds, near Cantrey Inlet, 67°14'08.6"N 95°10'11.9"W, *V. Johnston 47A1*, 3 July 1994, low-centred polygons, at south end of Murchison Lake, 68°05'43.8"N 92°39'22.8"W, *V. Johnston 3*, 1994 (DAO); in peat in turfy centre of high-centred polygons, approx. 15 km SE of Kinngaarjuit Hill south of the Murchison River, 68°24'13.2"N 93°05'15.8"W, *V. Johnston 51A1*, 5 July 1994 (DAO).

These collections represent a northwestward extension of the known range of some 650 km from Chesterfield Inlet (Savile and Calder 1952), and an eastward extension of the known range of some 800 km from a site west of Melville Sound adjacent to Coronation Gulf in District of Mackenzie. Korol (1992) reported an additional site in the District of Keewatin from Rankin Inlet, some 60 km southwest of Chesterfield Inlet.

*Ranunculus sabinei* R.B., Sabine Buttercup — KEEWATIN: Fly Camp 3, 65°53'N 98°34'E, Baker Lake area, *S. Smith 204*, 20 July 1983 (DAO).

This collection represents an extension of the known range southward from the northern coastal region of some 225 km.

### PAPAVERACEAE

*Papaver mcconnellii* Hultén, McConnell's Poppy — MACKENZIE: crustose lichen on stone talus, Northern Richardson Mountains, 68°05'N 136°22'17"W, *Loewen & Staniforth 93-006*, 4 July 1993 (DAO).

Hultén (1968) knew this endemic species from only two localities in the Yukon Territory. It is however much more frequent there (Cody 1994) and its status as a rare plant in that area should be reviewed. Previously known in the District of Mackenzie from a single collection on the Yukon-Mackenzie border at 67°33'N 136°12'W by J. A. Calder (Cody and Porsild 1968).

### BRASSICACEAE (CRUCIFERAE)

*Arabis arenicola* (Rich.) Gelert — MACKENZIE: on steep gravelly slope above lake, vicinity of south end of Contwoyto Lake, 65°45'N 111°15'W, *J. W. Thieret 9408*, 21-24 August 1962 (DAO); dry sandy areas, beaches, vicinity of Daring lake, 64°52'N 111°37'W, *McNair & O'Brien 31*, 4 August 1994 (DAO).

The collections cited here extend the known range of this arctic species of eastern North America formerly known to occur in the District of Mackenzie to longitude 110°W (Porsild and Cody 1980).

*Arabis holboellii* Hornem. var. *secunda* (Howell) Jepson (*A. holboelii* var. *retrofracta* sensu Porsild & Cody (1980) pro parte), Holboell's Rockcress — MACKENZIE: shallow soil in hollows of rock, Yellowknife near Giant Mine, *Cody & McCanse 2352*, 30 June 1949 (DAO); shallow soil in crevice of rocky hillside, Yellowknife, Joliffe Island, 62°27'N 114°23'W, *Cody & McCanse 2479*, 7 July 1949 (DAO); exposed sand slope of roadside, 24 miles south of Lower Hay River, 60°40'N 116°00'W, *W.H. Lewis 322*, 13 June 1951 (DAO); dry sand-ridge, exposed, Moraine Point, Great Slave Lake, 61°36'N 115°38'W, *W. H. Lewis 464*, 29 June 1951 (DAO).

This taxon, which occurs in the Gaspé Peninsula, Quebec, central Ontario, Saskatchewan to British Columbia and southern Alaska, is occasional in southern Yukon Territory north to Dawson; it has not previously been reported from the Northwest Territories.

*Arabis lyrata* L., Lyre-leaved Rockcress — MACKENZIE: pure sand by roadside, 1 mile west

of Seven Mile Lake, 28 miles west of Fort Smith, *Cody & Loan 4665*, 22 July 1950 (DAO) (determined by G. A. Mulligan) previously determined as *A. lyrata* L. var. *kamchatica* Fisch. and *A. kamchatica* (Fisch.) Ledeb.

*Arabis lyrata* is a North American species which extends from Ontario to Alberta, barely entering southwestern District of Mackenzie while *A. kamchatica* is an amphiberingian species which extends eastwards across Alaska and the Yukon Territory to the Mackenzie Mountains of western District of Mackenzie and the east side of Great Bear Lake and southward through British Columbia to southwestern Alberta and the state of Washington. *Arabis lyrata* is new to the flora of the Northwest Territories.

*Arabis pinetorum* Tidestrom (*A. holboelii* var. *retrofracta* sensu Porsild and Cody (1980) pro parte) — MACKENZIE: in shallow soil of crevice in igneous rock, Yellowknife, *Cody & McCanse 2085*, 11 June 1949 (DAO); dry sand ridge, Moraine Point, Great Slave Lake, 61°36'N 115°38'W, *W. H. Lewis 463*, 29 June 1951 (DAO); shallow humus over rock, Fort Reliance, 62°13'N 109°10'W, *W. J. Cody 14739*, 12 August 1965 (DAO) (determined by G. A. Mulligan).

This taxon which is found from Manitoba to British Columbia, Yukon and Alaska and south into northwestern United States has not previously been reported from the Northwest Territories.

*Braya glabella* Richards. ssp. *purpurascens* (R.Br.) Cody (*B. purpurascens* R.Br.), Low Braya — KEEWATIN: Rankin Inlet, *J.B. Korol 156* (SASK).

Korol (1992) reported this circumpolar subspecies as new to mainland District of Keewatin. The nearest site on Southampton Island is about 300 km to the northeast.

*Descurainia incisa* (Engelm. ex Gray) Britton ssp. *incisa* (*D. richardsonii* (Sweet) O.E. Schulz ssp. *incisa* (Engelm. ex Gray) Detting), Tansy-mustard — MACKENZIE: rare in heavy soil by airstrip, Norman Wells, *Cody & Gutteridge 7462a*, 22 July 1953 (DAO) (determined by G. A. Mulligan).

This taxon was growing with *D. incana* (Bernh. ex Fischer & C.A. Meyer) Dorn (*Cody & Gutteridge 7462b*) (*D. richardsonii* (Sweet) O.E. Schulz). According to Rollins (1993) it occurs in "mountains and foothills, Alberta to New Mexico, west to California, north to British Columbia". The northernmost collection seen from British Columbia was one mile west of Borolder Creek on Pine Pass-Dawson Creek Highway, approx. 55°37'N 121°58'W, *Calder & Kukkonen 27007*, 14 July 1960 (DAO). It is probably introduced at Norman Wells.

*Descurainia sophioides* (Fisch.) O.E. Schulz, Northern Tansymustard — KEEWATIN: vicinity of Rankin Inlet, *K. Reading 94-47*, 1994 (DAO).

This is an amphi-Beringian species which in the District of Mackenzie extends eastwards to the east end of Great Slave Lake and in the northeast, southwestern District of Franklin and is disjunct to eastern Baffin Island and northeastern Manitoba. The locality cited above which is the only one known in the District of Keewatin was previously reported by Korol (1992).

*Draba crassifolia* Graham, Rocky Mountain Whitlow-grass — KEEWATIN: talus below scarp W of 30-Mile Lake, 63°40'N 97°10'W, *K. Reading s.n.*, 1 September 1982 (DAO).

Previously known in the District of Keewatin from a single collection in the central region just south of the site reported here.

*Draba lactea* Adams, Milky Whitlow-grass — MACKENZIE: open sandy areas, top of esker, vicinity of Daring Lake, 64°52'N 111°37'W, *McNair & O'Brien 32*, 22 August 1994 (DAO) (determined by G. A. Mulligan).

This circumpolar species in the District of Mackenzie was previously known adjacent to the Arctic Coast and Richardson and Mackenzie mountains and southward into northern British Columbia where it is rare. The collection cited above represents an extension of the known range of some 280 km southwest from the head of Bathurst Inlet and some 360 km southeast from the vicinity of Coppermine.

*Draba norvegica* Gunn. — KEEWATIN: Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, 1991 (DAO).

New to mainland District of Keewatin; Mulligan and Cody (1968) reported the presence of *D. norvegica* near the east end of Great Slave Lake, a disjunct occurrence from Southampton Island, James Bay and the west coast of Quebec of some 1600 km; the collection cited here is intermediate between these two areas.

*Rorippa crystallina* Rollins, Asiatic Cress

This taxon was described by Rollins (1962) on the basis of specimens collected by John Thieret and Robert Reich along the Yellowknife Highway northwest of Fort Providence. It is now considered to be an introduction belonging to the genus *Nasturtium* and G. A. Mulligan has made the transfer to that genus, *Nasturtium crystallina* (Rollins) Mulligan (Mulligan and Cody 1995).

*Subularia aquatica* L. ssp. *americana* Mulligan & Calder, Awlwort — MACKENZIE: sandy shoreline, common, Tsu Lake, 60°35'N 111°52'W, *M. Anions s.n.*, 17 August 1980 (DAO).

This species is known in the District of Mackenzie from only four other localities: Great Bear Lake, (Porsild 1943), Indin Lake, Yellowknife (Cody 1956) and LeHaise Lake.

**SAXIFRAGACEAE**

*Ribes glandulosum* Grauer, Skunk Currant — KEEWATIN: very rare in rock scarps, Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, late August 1991 (DAO).

Not previously known from mainland District of Keewatin, but known to the south in adjacent Manitoba and to the west in southern District of Mackenzie Porsild and Cody, 1980).

*Saxifraga tenius* (Wahl.) H. Sm., Slender Arctic Saxifrage.

Korol (1992) reported this species as new to Continental District of Keewatin. His collections from Rankin Inlet [47 (SASK) and 57 (SASK, DAO] have since been revised to *S. nivalis* L., a circumpolar, arctic species which was mapped by Porsild and Cody (1980) from five localities in mainland District of Keewatin.

**ROSACEAE**

*Rubus idaeus* L. s.l. (*R. strigosus* Michx.), Wild Raspberry — KEEWATIN: in willow thickets along tundra streams, very local, north of Griffin Lake, 61°17'N 98°47'W, *K.L. Reading s.n.*, 2 August 1990 (DAO).

Previously known in the District of Keewatin from only two localities, one at the south end of James Bay and one on the mainland near the locality cited here (Porsild and Cody 1980).

*Sibbaldia procumbens* L., Sibbaldia — MACKENZIE: in mossy mats on lakeshore, vicinity of Daring Lake, 64°52'N 111°37'W, *McNair & O'Brien 37A*, 12 August 1994 (DAO).

This is a circumpolar species with large gaps in distribution. In the District of Mackenzie it is frequent in the Mackenzie Mountains but east of the Mackenzie River was previously known from a single collection at the west end of Great Bear Lake and then disjunct to southern mainland District of Keewatin (Porsild and Cody 1980).

**FABACEAE (LEGUMINOSAE)**

*Astragalus eucosmus* Robins., Eligant Milk-vetch — KEEWATIN: single colony on old raised lakebed gravel flat, "Nocamp" Lake, south of Yathkyed Lake, 62°21'N 97°26'W, *K. Reading 85-17*, 15 July 1985 (DAO); small colonies "Pebble Beach" Lake 62°22'N 97°30'W, south of Yathkyed Lake, *K. Reading 85-26*, 17 July 1985 (DAO); vicinity of Meliadine Lake, 63°01'N 92°10'51"W, *K. Reading 94-26*, 1994 (DAO); rock outcrop, 5 km NW of town of Rankin Inlet, 62°49'N 92°05'W, *J.B. Korol 171*, 19 July 1988 (DAO, SASK).

Korol (1992) reported the first collection from mainland District of Keewatin. The additional collections cited above demonstrate that it is more widespread in the Territory.

*Oxytropis viscida* Nutt. s.l. (*O. glutinosa* A.E. Porsild), Sticky Locoweed — MACKENZIE: near "Fishing Creek", Bathurst Inlet, 66°40'N 108°51'W, *P.M. Burt s.n.*, 9 July 1992 (DAO).

This collection represents an extension of the known range of some 650 km NE from the SW side of Great Bear Lake (Porsild and Cody 1980).

**VIOLACEAE**

*Viola epipsila* Ledeb. ssp. *repens* (Turcz.) Becker, Dwarf Marsh Violet — MACKENZIE: along a small stream with a cover of alder and willows, near the Burnside River, 66°20'N 109°22'W, *G.W. Scotter 96601*, 1 July 1992 (DAO).

This collection represents an extension of the known range NE from the south side of the Horn Plateau of some 750 km and ESE from the Richardson Mountains of some 1150 km.

*Viola renifolia* Gray var. *brainerdii* (Greene) Fern., Kidney-leaved Violet — KEEWATIN: sandy open forest and wet *Salix* thickets along stream, Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, early July 1991 (DAO).

New to the District of Keewatin; to the south this taxon is known from the vicinity of Churchill, Manitoba (Porsild and Cody 1980).

*Viola selkirkii* Pursh ex Goldie, Selkirk's Violet — MACKENZIE: Kraus Hotsprings, 61°14'N 124°02'W, *S.S. Talbot s.n.*, 23 July 1975 (CAN, photo DAO) (determined by J. G. Packer); rapidly drained bedrock substrate in *Carex-Dryas* alpine community, Gibson Ridge, Chick Lake, 65°53'N 128°05'W, *D. Gubbe 201*, 23 July 1973 (CAN).

New to the flora of the Northwest Territories north of 60°N latutide.

**ONAGRACEAE**

*Epilobium hornemanii* Reichenb., Hornemann's Willowherb — MACKENZIE: hidden in stand of *Epilobium* near creek, Hot Springs, one mile south of Canada Tungsten Mine, Mackenzie Mountains, 61°58'N 128°15'W, *K.W. Spicer 1506a*, 23 July 1967 (DAO).

This taxon is widespread in southern Yukon Territory (Cody 1994) and was expected to be found in adjacent District of Mackenzie (Porsild and Cody 1980).

**APIACEAE (UMBELLIFERAE))**

*Podistera macounii* (Coult. & Rose) Mathias & Const. (*Ligusticum macounii* Coult. & Rose; *L. mutellinoides* auth. non (Crantz.) Willar, Macoun's Lovage.

Welsh (1974) reported this tiny umbelliferous plant for northern Yukon and the adjacent Richardson Mountains in northwestern District of Mackenzie, on the basis of collections made by him in that area. It was unfortunately not included in Porsild and Cody (1980). The basis of this report is

MACKENZIE: on Jurassic Bug Creek Sandstone, West Cache Cr., 68°20'N 136°26'W, *S.L. Welsh 12012*, 20 June 1973 (CAN, BYU, photo DAO); ridge top in alpine tundra along West Cache Creek, 68°16'N 136°22'W, *Welsh & Rigby 12039*, 20 June 1973 (BYU, photo DAO).

**PYROLACEAE**

*Moneses uniflora* (L.) Gray, One-flowered Pyrola — KEEWATIN: in white spruce copses on tundra, protected places, deep moss, very local, small colonies, north of Griffin Lake, 61°02'N 98°12'W, *K.L. Reading s.n.*, 15 August 1990 (DAO).

New to mainland District of Keewatin.

*Pyrola minor* L., Lesser Wintergreen — KEEWATIN: riverside white spruce thickets, deep moss or grass, not common, Griffin Lake, 61°17'N 98°47'W, *K.L. Reading s.n.*, 10 August 1990 (DAO).

Previously known in mainland District of Keewatin from a single nearby locality; to the west, three localities near the Mackenzie-Keewatin border were plotted by Porsild and Cody (1980).

**ERICACEAE**

*Harrimanella hypnoides* (L.) Coville (*Cassiope hypnoides* (L.) D.Don), Moss Heather — KEEWATIN: SSW of Bissett Lake, 63°45'N 95°30'W, *K. Reading s.n.*, 28 August 1982 (DAO); snowbank habitat on east shore of lake, "Big Bird" Lake, 62°17'N 97°36'W, south of Yathkyed Lake, *K. Reading 85-22*, 16 July 1985 (DAO); mud along stream gorge, Fly Camp 2, 65°43'N 98°53'W, Baker Lake area, *S. Smith 163, 170*, 14 July 1983 (DAO).

Porsild and Cody (1980) knew this species in the Continental Northwest Territories from three localities, two in southeastern mainland District of Keewatin and one in the Thelon Sanctuary in eastern District of Mackenzie. The specimens cited here are intermediate between these two areas.

**LAMIACEAE (LABIATAE)**

*Monarda fistulosa* L. ssp. *menthifolia* (Grah.) Fern., Wild Bergamot — MACKENZIE: rocky exposed northwest-facing river bank, 3.5 miles up the Sainville River from Arctic Red River, 133°50'N 66°30'W, *R. Shotton s.n.*, 23 June 1972 (UBC, CAN).

This taxon was reported as new to the Northwest Territories by Straley (1986) on the basis of the collection cited above.

**SCROPHULARIACEAE**

*Pedicularis hirsuta* L., Hairy Lousewort — KEEWATIN: dry to moist tundra, Fly Camp 2, 65°43'N 98°53'W, Baker Lake area, *S. Smith 149*, 13 July 1983 (DAO); dry to moist tundra, Fly Camp 3, 65°53'N 98°34'E, Baker Lake area, *S. Smith 189*, 18 July 1983 (DAO).

In mainland District of Keewatin this species was only known to Porsild and Cody (1980) from adjacent to Queen Maud Gulf in the north and Hudson Bay in the east.

*Veronica longifolia* L., Speedwell — MACKENZIE: along sidewalk, disturbed ground, small wooded area, Fort Smith, 60°00'N 111°53'W, *M. Anions, s.n.*, 4 September 1980 (DAO).

This is a garden escape which is apparently rare in western Canada, but is found established more frequently in eastern Canada. New to the flora of District of Mackenzie and Continental Northwest Territories.

**LENTIBULARIACEAE**

*Utricularia intermedia* Hayne, Flat-leaved Bladderwort — KEEWATIN: rare - wet fen - one site only, Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, July 1991 (DAO).

Previously known in mainland District of Keewatin from only two sites in the southern part.

*Utricularia minor* L., Small Bladderwort — KEEWATIN: north of east end of Griffin Lake, 61°17'N 98°42'W, *K. L. Reading s.n.*, 1990 (DAO).

Previously known in the District of Keewatin only from the south end of James Bay. The nearest recorded sites are north of Lake Winnipeg in Manitoba, south of Lake Athabaska in Saskatchewan and at the east end of Great Slave Lake in the District of Mackenzie (Porsild and Cody 1980). It is also known from the Nero Lake region north of Lake Athabaska, LaLocke, Wathaman Lake west of Reindeer Lake, and Trade Lake on the Churchill River in northern Saskatchewan (V. L. Harms, personal communication, 1995). In the northern part of its range this species is nearly always sterile, as is the present collection, and easily overlooked.

**RUBIACEAE**

*Galium tridifum* L., Small Bedstraw — KEEWATIN: local, Cullaton Lake area, 61°20'N 97°40'W, *K. L. Reading s.n.*, 1991 (DAO).

Previously known in the south of the District of Keewatin from only two other localities (Porsild and Cody 1980).

**CAPRIFOLIACEAE**

*Viburnum edule* (Michx.) Raf., Low-bush Cranberry — KEEWATIN: locally common, Cullaton Lake area, 61°20'W, 97°40'W, *K.L. Reading s.n.*, 1991 (DAO).

Previously known in mainland District of Keewatin from a single locality west of Cullaton Lake (Porsild and Cody 1980).

**Adoxaceae**

*Adoxa moschatellina* L., Moschatel — MACKENZIE: Liard River Valley, east bank on terrace slope just above mouth of Kotanellee River, *W.W. Jeffrey 134*, 10 July 1959 (CAN); wet silt under *Salix* back from lake shore, Fisherman Lake, 60°20'N 123°47'W, *S.M. Lamont FL23*, 7 June 1973 (DAO);

growing on lowest lake terrace in a moist area beneath *Salix*, Fisherman Lake, 60°20'N 123°48'W, *S.M. Lamont FL484*, 21 June 1974 (DAO).

The specimens cited above are the basis for the District of Mackenzie locality mapped by Porsild and Cody (1980). Hultén and Fries (1986) mapped a second locality south of Great Slave Lake adjacent to the Slave River which has been repeated by McJannet et al. (1995). The basis for this record has not been found but it might possibly be a misplacement of a site in the Caribou Mountains west of Wood Buffalo National Park at approximately 59° latitude in northern Alberta (Lee et al. 1982).

**COMPOSITAE**

*Chrysanthemum integrifolium* Richards., Entire-leaved Daisy — KEEWATIN: moist tundra, Fly Camp 3, 65°53'N 98°34'W, Baker Lake area, *S. Smith 195*, 20 July 1983 (DAO).

Porsild and Cody (1980) knew this species in the extreme north of mainland District of Keewatin. The specimen cited here is from a site some 200 km to the south in the interior.

*Erigeron alpiniformis* Cronq., Fleabane — FRANKLIN: dry west facing slope on middle basin of lakes, Ogac Lake, Frobisher Bay, *I.A. McLaren 113*, 1962 (CAN).

Cronquist (1947) knew this taxon, which he separated from *E. uniflorus* and *E. alpinus*, only from Greenland at the time he described it. It is new to Baffin Island and the Northwest Territories and was mapped without comment by McJannet et al. (1993).

*Erigeron elatus* (Hook.) Greene — KEEWATIN: Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, 1991 (DAO); Padley River [Padlei River 61°53'N 96°42'W], *W.C. Güssow s.n.*, 9 August 1932 (DAO).

Previously known in mainland District of Keewatin from a single site west of Cullaton Lake (Porsild and Cody 1980).

*Petasites frigidus* (L.) Fries ssp. *frigidus*, Sweet Coltsfoot — KEEWATIN: ubiquitous, Cullaton Lake area, *K.L. Reading s.n.*, 1991.

Previously known in the District of Keewatin from only one locality in the extreme northwest.

*Petasites frigidus* (L.) Fries ssp. *palmatus* (Ait.) Cody (*P. palmatus* (Ait.) Gray), Palmate-leaved Coltsfoot — KEEWATIN: ubiquitous, Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, 1991 (DAO).

This is the third collection of this taxon in southern mainland District of Keewatin (Porsild and Cody 1980).

*Petasites sagittatus* (Banks) Gray, Arrow-leaved Coltsfoot — KEEWATIN: ubiquitous, Cullaton Lake area, 61°20'N 97°40'W, *K.L. Reading s.n.*, 1991 (DAO); "Pebble Beach" Lake, 62°22'N 97°30'W, south of Yathkyed Lake, *K. Reading 85-24*, 17 July 1985 (DAO).

These are the second and third collections of this taxon from southern mainland District of Keewatin.

*Senecio ogotorukensis* Packer (*S. conterminus* sensu Hultén (1968) pro parte), Groundsel — MACKENZIE: Mackenzie Mountains, top of steep eroding west-facing slope, Mirror Lake, east side of Carcajou Range, 64°52'N 126°55'W, *Cody & Brigham 20404*, 3 July 1972 (DAO).

Cody (1994) extended the known range of this taxon into northern Yukon Territory; the collection cited here extends the known range into western District of Mackenzie. New to the flora of the Northwest Territories.

*Solidago graminifolia* (L.) Salisb. var. *major* (Michx.) Fern., Goldenrod — MACKENZIE: rocky shoreline, Tsu Lake, 60°35'N 111°52'W, *D. Campbell, s.n.*, 19 August 1980 (DAO).

To the south this species has been reported about Lake Athabaska in both Saskatchewan and Alberta (Raup 1936 - sub var. *camporum* (Greene) Fern.). Elsewhere in the District of Mackenzie *S. graminifolia* var. *major* is known only in the Mackenzie River valley between Fort Simpson and Fort Wrigley (Porsild and Cody 1980).

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# Ecological Replacement of the Deer Mouse, *Peromyscus maniculatus*, by the White-footed Mouse, *P. leucopus*, in the Great Lakes Region

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The possible ecological replacement of the boreal, long-tailed Forest Deer Mouse *Peromyscus maniculatus gracilis*, by the White-footed Mouse, *P. leucopus noveboracensis*, in Wisconsin was studied by analysis of the zoogeography (parapatric distribution and relict populations of *P. m. gracilis* in the south and on islands), and by surveying relative population abundance on Washington Island, where competition probably commenced in 1987, upon the arrival of *P. leucopus*. In Wisconsin, the geographic range of *P. leucopus* is expanding northward, and *P. maniculatus gracilis* has vanished in the south and on the Door Peninsula. The White-footed Mouse thrives in brushy and dry forest habitats (often nesting in ground burrows), and the Forest Deer Mouse seems both adapted to high tree branches and cavities, to cold weather, and to boreal (conifer, mixed conifer) forests. On Washington Island, after an initial increase of *P. leucopus* and the concomitant near extinction of *P. m. gracilis*, both species have coexisted at low to medium densities during the mild winters of the past three years.

Key Words: *Peromyscus leucopus*, White-footed Mouse, *Peromyscus maniculatus gracilis*, Forest Deer Mouse, Wisconsin, ecological replacement, islands.

The exclusion of one organism from the niche of another is difficult to demonstrate (Connell 1983; Schoener 1983). Both east and west of Lake Michigan, the White-footed Mouse, *Peromyscus leucopus*, and the Forest Deer Mouse, *P. maniculatus gracilis*, formerly occupied almost parapatric (non-overlapping) geographic ranges. In Wisconsin, the Forest Deer Mouse occupied the boreal areas supporting spruce, fir, and mixed conifer-deciduous forests, whereas the White-footed Mouse inhabited brushy prairies, oak savannas, forest edge, and river bottoms north to the contact. A "tension zone" or ecotone, separates these boreal and southern (austral) areas (Curtis 1959; Stearns and Kobriger 1975; Long 1974). Balsam Fir (*Abies balsamea*), White Spruce (*Picea glauca*), Eastern Hemlock (*Tsuga canadensis*), Paper Birch (*Betula papyrifera*), Sugar and Red Maple (*Acer saccharum* and *A. rubrum*), White Cedar (*Thuja occidentalis*)and Beech trees (*Fagus grandifolia*) are found in northern lower, wetter, areas. On higher ground are White Pine (*Pinus strobus*), Oak (*Quercus rubra*) and Balsam Fir. Oak (*Q. macrocarpa*)-maple savanna, Jack Pine (*P. banksiana*), birch woods, hickories (*Carya cordiformis*, *C. ovata*), Sycamore (*Platanus occidentalis*) and White Pine forest characterize southern Wisconsin. The two *Peromyscus* species seemed adapted to different zones, and contrasting climates and vegetation apparently resulted in their north-south juxtaposition (Hooper 1942; Long 1974).

Miller (1893: 63) suggested that owing to human modification and land use, *P. leucopus* ranged northward, approaching the Forest Deer Mouse in New York and western Massachusetts. Hooper (1942) found the same kind of dispersion and replacement in lower Michigan where *P. m. gracilis* was confined to northern counties, and *P. leucopus* had moved northward up the entire Lower Peninsula. Thus, ecological replacement is a pattern in all three separate and approximately concurrent northward invasions. The similar habitat requirements and close resemblance of the two long-tailed species have been noted often (Long and Long 1993; Horner 1954; Wolff 1985).

In addition to occurring with *P. m. gracilis* in the latter's habitats, *P. leucopus* thrives where *P. m. gracilis* is seldom or never found (e.g., sandy brushland, beaches, old field, rights of way, hedge rows, prairies (Getz 1961; Long and Long 1993; Long 1974, 1978; Jackson 1961). However, *P. leucopus* does not dominate in swamps and northern latitudes.

Although both long-tailed species show similar patterns of thermogenesis and accumulation of brown fat (e.g., Zegers and Merritt 1988; Lynch 1973) and in some states show little loss of mass in winter, in Wisconsin at the northern edge of its range *P. leucopus* shows a significant loss of mass and/or heavy mortality in severe winters which are characterized by cold temperatures and lack of snow cover (resulting in deep frost) (Long 1973). Pierce and Vogt (1993); Tannenbaum and Pivorun (1988); and Wolff and Durr (1986) found *P. maniculatus* superior to *P. leucopus* in winter adaptations including torpor, larger nests, larger hoards of food, regressed sexual organs, and lower food consumption.

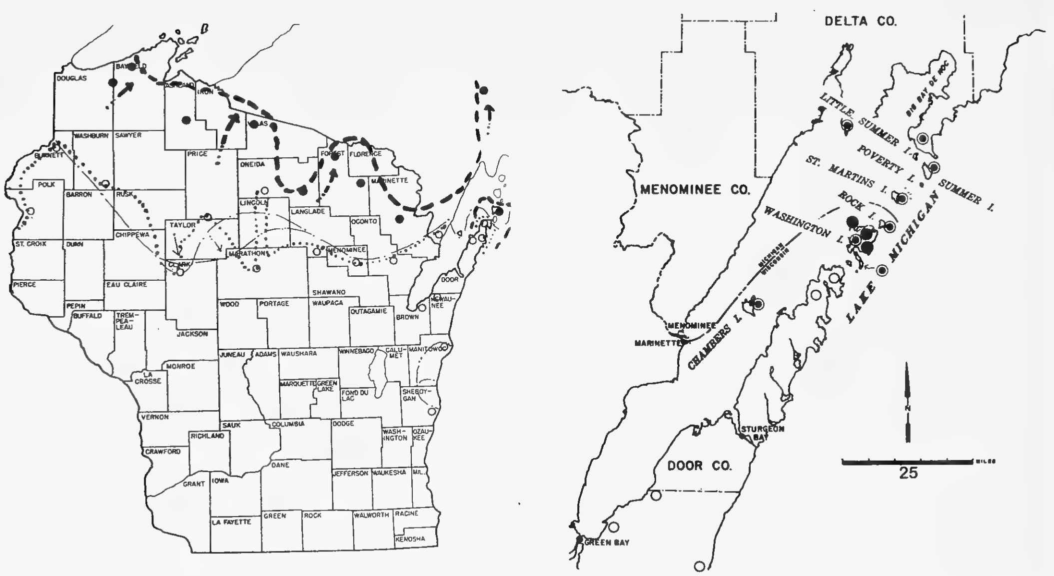


FIGURE 1. Map of the region. Left: Upper boldly dashed boundary, geographic range for *Peromyscus leucopus*, based on recent records (black dots). Dotted boundary, range for the same species based on Jackson's records prior to 1961 (open circles). The fine-line boundary is that for *Peromyscus maniculatus gracilis*. It has shown little change in historic times except a somewhat reduced range. Right: Door Peninsula, Green Bay, Lake Michigan, and the isles in Green Bay. Black dots and open circles as above. Bull's-eye dots represent occurrences of *P. m. gracilis* throughout the islands and northward, but not on the Door Peninsula.

After *P. leucopus* established itself on Washington Island (in 1987) and subsequently increased its density dramatically (Figure 1), apparently at the expense of *P. m. gracilis*, the two kinds have been studied intensively. This study examines the interrelations of two formerly parapatric long-tailed *Peromyscus* now inhabiting the same woodlands.

## Materials and Methods

Museum special snap traps baited with a mixture of oats and peanut butter were set in linear series of 25-50 stations (two traps at each) at intervals of 10 m. Trapping was carried out 20 years. Each line was left out only one night, but often the line was re-run in nearby transects, on successive nights. Most specimens were preserved for future identification, but where abundance was high, only counts were made.

The number of mice caught was adjusted over 100 trap nights. Sampling was usually during the autumn, occasionally in spring. Mice in hand were identified by tail length, ear length, vibrissae length, tail pencillate or not, and (in most specimens) by skull shape and length (see Long and Long 1983). Most (approximately 275) preserved specimens, except three examined from the United States National Museum (Natural History), were placed in the University of Wisconsin-Stevens Point Museum collection.

Habitat types are defined as follows:

1. Sand dunes with beach grasses, spreading junipers (*Juniperus* sp.), legumes (*Lathyrus maritimus*), legumes, dwarf iris (*Iris lacustris*), willows (*Salix* sp.) and other shrubs sparsely covering the sand.
2. Old field-fence row. Tall grasses and forbs, including field composites, milkweed (*Asclepias syriaca*), vetch (*Vicia villosa*), brambles and saplings (occasionally planted Red Pine, *Pinus resinosa*) growing along field-stone fences.
3. Maple-beech forest with White Cedars, Oak, Fir, Paper Birch and Hemlock interspersed, and a ground flora of ferns, raspberries, young maples and beeches, chokecherries (*Prunus virginiana*), birches, sparse grasses, numerous rocks and rotted stumps and logs.

Lorraine Andersen, certified by the U.S. Weather Service, supplied the weather data collected by use of standard meteorological methods. In addition to monthly records, the last five winters were compared by use of average temperatures, snowfall and snow cover.

## Results and Discussion

### *Invasion of Washington Island*

Members of the United States Biological Survey collected mammals on Washington Island, Lake Michigan, in 1917. These workers found *P. m. gra-*

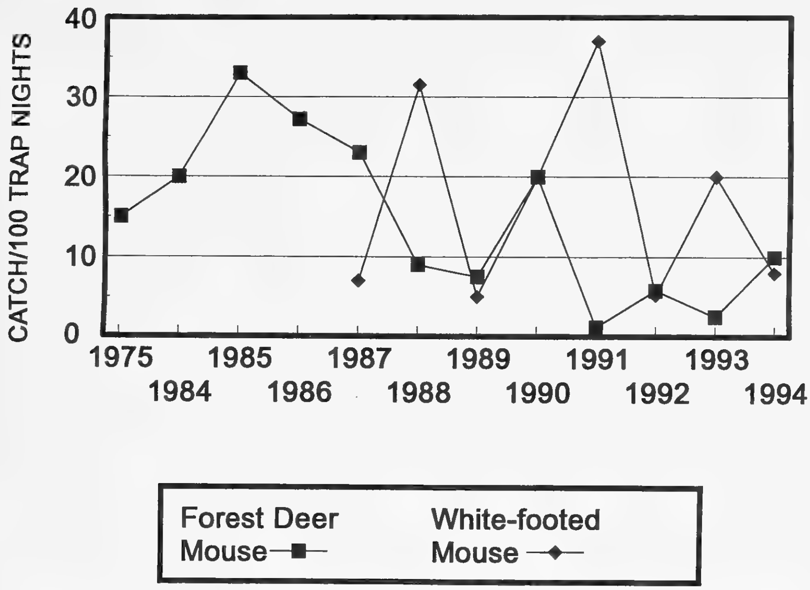


FIGURE 2. Annual abundance of two long-tailed *Peromyscus* from 1976-1994, on Washington Island, Lake Michigan.

*cilis* but no *P. leucopus* on this 14 000 acre (5600 ha) island.

After eleven years of collecting only *P. m. gracilis* on Washington Island, *P. leucopus* first appeared in 1987 (Long and Long 1993). One year later it had apparently spread several miles to Boyar's Bluff from the Pedant's Lane forest, both similar beech-maple-oak-hemlock-cedar and birch assemblages on the north side of the Island.

In subsequent years the White-footed Mouse was caught on sand dunes, along hedges and stone fences, in bird houses, and in old fields where *P. m. gracilis* had never been taken. In 1992, *P. leucopus* showed up on Hemlock Drive and at Sand Dunes beach across the Island from where it was first found. In numbers (Figure 2) and in diverse habitats (Table 1) it had increased. Concomitantly the numbers of *P. m. gracilis* steadily decreased, and it was not taken at all in some dryer forest habitat where it formerly thrived (Table 1, Figure 2). Since 1987, a total of 168 *P. leucopus* were collected mostly in beech-maple forest, compared to 67 *P. m. gracilis.*

Hooper (1942) reported *P. m. gracilis* thrives best in dense upland beech, maple, yellow birch, hardwoods, and also in bogs, brush, jackpine, dune heath, and conifer swamps (Dice 1925). *P. leucopus* in Michigan prefers oak-hickory woods with a diverse understory (Allen 1938; Burt 1940; Getz 1961). Batzli (1977) found *P. leucopus* in wet lowlands in Illinois. Long (1968) and Hoffmeister (1989) reported *P. leucopus* from brushy prairie in central Illinois. Long (1973) found them abundant in jack pine-oak savanna, hazelnut groves, white pine forest and wooded ravines in central Wisconsin. Howard (1951) found White-footed Mice vulnerable to cold winters, perhaps giving an ecological edge in the boreal areas to *P. m. gracilis*. Long (1973) found that deep frosts (resulting from thin snow cover) practically extirpates *P. leucopus* in central Wisconsin, but the populations recover by the subsequent fall. The two species are now parapatric there.

Stah (1980) found that both species prefer to nest above ground level, in tree cavities and hollows but that *P. leucopus* shifts to ground nesting when competing with *P. m. gracilis.* In an earlier study, Stah (1978) found *P. leucopus* to be more aggressive. The Forest Deer Mouse may be better adapted to the arboreal nesting. At certain seasons when seeds and fruits, numerous arthropods, and acorns (cached by squirrels as well as mice) are available on the ground, *P. leucopus* seemingly out competes *P. m. gracilis*. The latter is superior (having well-developed cheek pouches) in hoarding food in summer or winter, an advantage unless *P. leucopus* steals from these caches (Pierce and Vogt 1993).

Analysis of stomachs of 26 specimens taken at Pedant's Lane indicated that *P. leucopus* survived the winter in the vicinity of oaks by feeding on acorns on the ground, and also ate arthropods, beech nuts, maple and grass seeds, and pits of chokecherries. Subsequent trapping (1994) suggested adult *P. m. gracilis* with young were feeding on acorns from the same oaks. Clark (1972) working mostly in northern Clark County, in hemlocks and hardwoods

TABLE 1. Percent of Washington Island *Peromyscus* species found in three habitats, 1975, (N = 12), 1984-1986 (N = 99), 1987-1990 and in 1991-1994 (N = 235 mice).

| | Sand Dunes | Old Fields | Beech-Maple Forest |
|---|---|---|---|
| **1975** | | | |
| *P. leucopus* | 0 | 0 | 0 |
| *P. maniculatus* | 0 | 0 | 100 |
| **1984-1986** | | | |
| *P. leucopus* | 0 | 0 | 0 |
| *P. maniculatus* | 0 | 0 | 100 |
| **1987-1990** | | | |
| *P. leucopus* | 10 | 5 | 55 |
| *P. maniculatus gracilis* | 0 | 0 | 29 |
| **1991-1994** | | | |
| *P. leucopus* | 21 | 11 | 50 |
| *P. maniculatus gracilis* | 0 | 0 | 17 |

(68 percent of his specimens of *P. leucopus*) found in *P. leucopus*, that 22% of the volume was composed of green plants and 63% seeds, whereas in *P. m. gracilis*, 47% was green plants and 44% seeds. Wolff et al. (1985) when comparing the subspecies *P. m. nubiterrae* with *P. leucopus* found seasonal differences in proportions of green plants and anthropods eaten but similarity over the total yearly diet. *P. maniculatus* ate more arthropods in summer and green vegetation in autumn, and *P. leucopus* ate more green vegetation in summer, more arthropods in autumn.

Some fruits, seeds, acorns and other available forest foods are occasionally found in the stomachs in both species. White pulpy material was usually minced acorn meat, but some of it was the white material in eggs of Carpenter Ants (*Camponotus herculeanus*). In several July-taken mice, both species were feeding on Carpenter Ants. Jaws, parts of chitinous exoskeletons, one jaw with muscle attached, and one thin brownish covering of a pupa were observed, intermixed with the white minced pulpy material. If these mice habitually feed on Carpenter Ants, not only are they competing for a forest resource, but the ant colonies can provide food for these mice in tree cavities in most months of the year.

*Weather*

As cold winters supposedly favor *P. m. gracilis* and not *P. leucopus*, the possible correlation of snow and cold temperature and abundance of mice on Washington Island was examined (Table 2). On Washington Island, the climate in the past five years seemed mild. It was milder than the 1951 through 1980 normals. There was less water in the swamps in 1994, but in March there were only two inches (50 mm) less of snow cover (Table 2). From 1989 through 1993, snow cover varied from 0 to 20 inches (50 cm) in winter. In 1993-1994 there was no more snowfall and snow cover than usual, and the mean temperature was the least of the past five years. There was a low of –24° F (= –31°C). This "hard winter," which historically was judged also to be "mild," may have had little effect on the *Peromyscus* populations of either species. The effect of cold which would be expected to be adverse for *P. leucopus* may have been mitigated by the snow cover. The greatest discrepancy in abundance was in 1991 (Figure 2). That year *P. m. gracilis* almost disappeared from our samples and *P. leucopus* peaked. Since then *P. m. gracilis* seemed to be holding its own though low numbers are evident for both species. A very cold winter hypothetically might favor a recovery of *P. m. gracilis* back to former abundance and depress *P. leucopus*. In contrast, a very mild winter might be expected to favor *P. leucopus*, although in Kansas, where winters are milder, temperature was not important to the abundance of *P. leucopus* (Kaufman et al. 1995).

In northern Wisconsin, a Kohn Winter Severity Index (WSI) (McCaffery 1994) was based on the number of zero or below zero °F days and 18-inch (45 cm) snowfalls, was calculated. Data were collected from 32 Department of Natural Resources stations. The winter of 1993-1994 was only the third time Lake Superior froze over in 20 years. However, the number of subzero nights was little different (41 to 42 in 1993-1994) than usual. The mean WSI was 48, which was classed as "mild", the fourth mild rating in the past five years. Snow depths varied in the 15-17 inch (380-430 mm) range, with crusted conditions in some places. Deep snow is adverse to deer, but the deer herd was in good condition (McCaffery 1994). *P. leucopus* actually benefits when the snow cover is deep (Long 1973). Thus, climatic pattern in northern Wisconsin confirms the local findings on Washington Island. The winters have not been severe.

What if winters were severe? Wolff and Durr (1986) and Wolff and Hurlbutt (1982) found that *P. maniculatus* tended to nest high in hollow trees. Only three nest sites were underground whereas 36 were in trees. In *P. leucopus* 43 nests were underground and 36 were in trees but *P. maniculatus* averaged higher nest height in trees (7.4 m to 4.3 m in mean height). *P. leucopus* often moved to underground burrows in winter. Madison (1984) found that *P. leucopus* at the northern limits of its geographic range is vulnerable to thin snow and deep frost in large part because it often dwells in underground nests. This may also account for its avoidance of wet areas such as swamps and marshes.

The warmest winter I observed during this study was during a time when *P. leucopus* populations declined. More extreme temperature fluctuation than observed in recent years may affect the relative abundance, especially a combination of thin snow

TABLE 2. Winter weather data for Washington Island, 1989-1994. Temperature in degrees C. Snow in inches (and mm). Index explained in text.

| Date | High/Low | Mean Temp | Departure Norms 1951-1980 | Snowfall/ Cover | Winter Low |
|---|---|---|---|---|---|
| November 1993 | 10.6/-8.9 | 1.7 | -0.8 | 6/1 (152/25) | |
| December | 7.2/-20 | -2.7 | 1.2 | 2/1 (50/25) | |
| January 1994 | 2.2/-31 | -9.0 | -0.9 | 28.5/20 (723/507) | |
| February | 5/-8.3 | -10.5 | -3.5 | 12/16 (305/406) | |
| March | 12.2/-13.8 | -1.1 | 0.8 | 9/3 (228/76) | |
| **Means 1994** | | **-4.3** | **-0.6** | **11.5/8.2 (292/207)** | **-31** |
| November 1992 | 10/-10 | 1.7 | -0.8 | 6.5/2 (165/50) | |
| December | 4.4/-16 | -2.8 | 1.2 | 9/3 (228/76) | |
| January 1993 | 7.8/-17 | -5.8 | 2.3 | 8/5 (202/126) | |
| February | 6.1/-20.5 | -7.3 | -0.1 | 6/6 (152/152) | |
| March | 15/-15 | -0.9 | 1.1 | 3/5 (76/126) | |
| **Means 1993** | | **-3.0** | **0.7** | **6.5/4.2 (165/104)** | **-20** |
| November 1991 | 11.1/-10 | 0.8 | 1.7 | 5.5/3 (139/76) | |
| December | 5.6/-15 | -2.7 | 1.2 | 12.5/8 (317/202) | |
| January 1992 | 5.6/-21 | -4.8 | 3.2 | 10.5/3 (317/76) | |
| February | 3.3/-21 | -3.4 | 3.6 | 11/5 (279/126) | |
| March | 10/-15 | -1.8 | 0.5 | 9/6 (228/152) | |
| **Means 1992** | | **1.3** | **2.1** | **9.7/5 (246/126)** | **-21** |
| November 1990 | 16.7/-5 | 4.3 | 1.8 | 0/0 (0/0) | |
| December | 2.2/-20.5 | -2.9 | 0.9 | 10.5/6 (166/152) | |
| January 1991 | 2.8/-25 | -8.5 | -0.6 | 9/7 (228/177) | |
| February | 8.9/-21.7 | -4.5 | 2.6 | 5/6 (126/152) | |
| March | 11.1/-12.2 | -0.3 | 2.0 | 3/4 (76/101) | |
| **Means 1991** | | **-2.4** | **1.3** | **5.5/4.6 139/117)** | **-25** |
| November 1989 | 11.1/-14.4 | -0.1 | -2.6 | 8/3 (202/76) | |
| December | 3.3/-25 | -7.6 | -3.8 | 22.5/10 (570/25.4) | |
| January 1990 | 5/-15.5 | -3.2 | 4.8 | 13/10 (303/25.4) | |
| February | 5.6/-18.3 | -5.4 | 1.7 | 7/8 (177/202) | |
| March | 13.9/-16.1 | -0.2 | 2.1 | 0/5 (0/126) | |
| **Means 1990** | | **-3.3** | **0.4** | **10.1/7.2 (254/180)** | **-25** |

and cold temperature (Long 1973). However, in central Wisconsin the penetration of soil frost is significantly deeper than anywhere in the state (Zimmermann 1991), but *P. leucopus* is the most abundant small mammal there. Dry soils and savanna plants such as Jack Pine and Beaked Hazelnut (*Corylus cornuta*) allow *P. leucopus* to thrive, but *P. m. gracilis* seems excluded from sand habitats.

*Rate of Replacement*

When two species have similar ecological requirements such as food and nest sites, and similar morphology, then both species should increase when conditions are optimal and likewise both should decline when conditions are unfavorable. When one species cycles up and the other down, then superior niche exploitation might explain the difference (Figure 2).

One species probably does not take over another's habitat in a few years (Scott and Deuser 1992; Mellhopp and Lynch 1978). Fitch (1979) showed that *P. m. gracilis* can invade and select open ground habitats such as lichen-prairies and woodlots. On Washington Island, open habitats have apparently never been filled by *P. m. gracilis*. Although replacement of *P. m. gracilis* by *P. leucopus* on Washington Island may not take place soon, the results in the year 1991 suggested it might in the long term (Figure 2).

Wolff (personal communication: unpublished manuscript) concludes *P. leucopus* gains a numerical advantage over deer mice in summer and times of food abundance. Deer mice have higher survival in winter and in times of food shortages, but fluctuating conditions are frequent enough to permit coexistence, in the short term. Such fluctuations probably delay ecological replacement.

*Biogeography* (see Figure 1)

In northern Clark County, and adjacent areas in Taylor, western Marathon, and southern Price coun-

ties, Clark (1972) found no evidence for ecological replacement. Both species were abundant except that *P. leucopus* was rare in wet habitats. Schmidt (1931) found that both species in nearby western Clark County preferred the same habitat, mesic hemlock-hardwoods, but *P. leucopus* occurred a little southward of *P. m. gracilis*. Both species in Clark County ate the same general foods ("green plants and seeds"), suggesting competition for food (Clark 1972), but there was no evidence given of resource limitation.

Jackson (1917) mentioned a southern relict population of *P. m. gracilis* occurring in the Sheboygan Marsh, which probably persisted there because the marsh had cool, moist habitats. Such habitats are not preferred by *P. leucopus* (Long 1974; Clark 1972). Jackson (1961) implied that *P. m. gracilis* had been eradicated there, something easier to speculate than to prove. However, two collections have been made, and only *P. leucopus* were taken. A second relict population has been found in Manitowoc County and it too seems surrounded by populations of *P. leucopus*, with no connections to the *P. m. gracilis* northward (Figure 1).

These small populations might be southward range extensions instead of relict populations left after the main range withdrew northward. The other evidence, however, indicates a northward invasion by *P. leucopus* into northern Wisconsin and Upper Michigan, only recently reaching as far as Lake Superior (Long and Long 1993) and Upper Michigan (Baker 1983). The parallel movement in Lower Michigan (Hooper 1942), and an interesting pattern of distribution in Door County, Wisconsin, and nearby habitats of Upper Michigan (Long 1978) provide sound evidence of ecological replacement of *P. m. gracilis* by *P. leucopus* (Figure 1).

On the Door Peninsula (Figure 1), a huge boreal thumb of land jutting into Lake Michigan, and separated from Upper Michigan by the waters of Green Bay, there are no records of boreal *P. m. gracilis* in spite of intensive collecting since 1910. Available habitats are everywhere, permitting other boreal mammals such as the Red Squirrel (*Tamiasciurus hudsonicus*), Northern Flying Squirrel (*Glaucomys sabrinus*) and Red-backed Vole (*Clethrionomys gapperi*) to thrive in the beech-maple and fir-white pine forests.

Apparently *P. leucopus* has been long established on the peninsula. Robert Howe and T. Erdmann of the University of Wisconsin-Green Bay showed me skulls of *P. leucopus* from a Door County cave. These remains were associated with other non-boreal mammals, and were dated at approximately 600 years BP, certainly no earlier than 1000 years.

The Forest Deer Mouse is abundant offshore in Green Bay (Chambers Island) and north of the ship passage called Door of Death (Porta des Morts), on Detroit Island (recent specimens of *P. m. gracilis* taken there by Thor Purinton and myself), Washington Island, Rock Island, St. Martin's Island, and Big Summer Island (see Long 1978). Either *P. leucopus* replaced *P. m. gracilis* on the Door Peninsula and has been unable to cross the waters to the nearby islands, or *P. m. gracilis* has colonized *all* these islands without successfully reaching the Door Peninsula.

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# A Contribution to the Biology of the White-beaked Dolphin, *Lagenorhynchus albirostris*, in Waters off Newfoundland

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Twenty-one ice entrapments, nine strandings and three incidental captures in fishing gear of White-beaked Dolphins (*Lagenorhynchus albirostris*) 1979-1990 in Newfoundland waters are summarized. The results of autopsies from two ice-entrapped groups include body measurements, age estimates and stomach contents. Body-length criteria for physical maturity were determined from the degree of fusion of the bones in the flippers. On average, male White-beaked Dolphins become physically mature at a length of 281 cm and an age of 13 years; females reach physical maturity at an average body length of 261 cm and an age of 16 years, but there was considerable variation in size at sexual maturity.

Key Words: White-beaked Dolphin, *Lagenorhynchus albirostris*, ice entrapment, stranding, by-catch.

Little is known of the biology of the White-beaked Dolphin, *Lagenorhynchus albirostris* (Gray 1846). It is one of two species of *Lagenorhynchus* found in the North Atlantic; the second is the Atlantic White-sided Dolphin (*Lagenorhynchus acutus*). Ranges of the two dolphins are similar, although White-beaked Dolphins are more northerly animals (Evans 1980; Leatherwood et al. 1976). In northwest Atlantic waters, White-beaked Dolphins are known to summer in the Davis Strait and off Labrador; they can be found as far south as Cape Cod, Massachusetts, in the winter and spring (Leatherwood et al. 1976; Alling and Whitehead 1987). A summer population off southern Labrador of 3500 individuals and an annual mortality of 10% from hunting and incidental bycatch has been estimated (Alling and Whitehead 1987).

This paper presents information on the ice entrapments and strandings of White-beaked Dolphins in Newfoundland which occurred between 1979 and 1990 and the results of autopsies on several ice-entrapped groups.

## Method

### *Reporting Network*

Reports on strandings, captures in fishing gear and ice entrapments of cetaceans in Newfoundland were received via a widely advertised, toll-free, province-wide telephone line. Several agencies, including the Department of Fisheries and Oceans, the Newfoundland and Labrador Department of Fisheries, the Canadian Coast Guard and the Royal Canadian Mounted Police, referred reports of cetaceans to the entrapment and stranding network. A full description of the network is available in Lien (1994).

When reports of ice entrapments were received, reliable local authorities were contacted to investigate the report and supply additional information. In most cases, crews were dispatched to the sites of the entrapments to verify the reports and to assist in rescue efforts or autopsies. Entrapments were routinely photographed.

### *Autopsied Specimens*

White-beaked dolphin specimens for autopsy were obtained from two ice entrapments (Table 1). The first entrapment occurred in Grand Bay, Port-aux-Basques (47° 34'N, 59° 04'W) on 9 March 1982, and the second at Point Verde, Placentia Bay (47° 14'N, 54° 01'W) on 25 March 1983 (Figure 1). Additional animals from the latter entrapment were found on 26 March less than 1 km from the original entrapment location; these animals were included with the Point Verde sample. The entrapments were initially described in the annual reports of the entrapment and stranding network (Lien et al. 1982; Lien et al. 1983).

### *Port-aux-Basques Ice Entrapment*

Little is known about the ice entrapment which occurred in Grand Bay, Port-aux-Basques. Pack ice moved toward the shore with southwesterly winds and covered the bay on 9 March 1982. Several beached animals were observed by a hunter and reported that evening. Initial examinations were done on 10 March at which time all of the animals were dead. Examinations were completed on 11 March.

Because of the extremely heavy pack ice on and near the shore where the animals died, it is not certain that all trapped animals were found. Thirty-nine dolphins were found beached at low tide on 10 March; one additional animal had been taken for

FIGURE 1. Locations of ice entrapments and strandings of White-beaked Dolphins (*Lagenorhynchus albirostris*) in Newfoundland (1979-1990). (* indicates ice entrapment; # indicates stranding)

food the previous evening. The severe ice conditions made complete examination of all animals impossible. Twenty-two of the dolphins were examined in detail while incomplete data was gathered as possible on the remaining 17 animals. Sex was determined for 34 animals.

*Point Verde Ice Entrapment*

Pack ice moved inshore at Point Verde near midnight on 24 March 1983; the ice entrapment of the dolphins probably occurred at that time. Investigators arrived at the site on 25 March. A total of 59 dolphins were initially visible in the pack ice; 39 of the animals were already dead. It is likely that additional animals had been killed in the entrapment as there was a great deal of blood on ice where dolphins were not visible.

At the time of the crew's arrival, live animals were being crushed and squeezed by heaving ice. Ice maps of Placentia Bay showed no water nearby likely to remain open; therefore, 20 of the live dolphins were killed by shooting.

In addition to the animals at Point Verde, nine dolphins in ice were located offshore by a helicopter. Seven of these animals were dead. An estimated 80-100 dolphins and a single Minke Whale (*Balaenoptera acutorostrata*) were found swimming in a small lead of open water in Placentia Arm, about 1 km from Point Verde.

The total number of White-beaked Dolphins trapped in ice in the area of Point Verde was in excess of 150 individuals; the number of animals

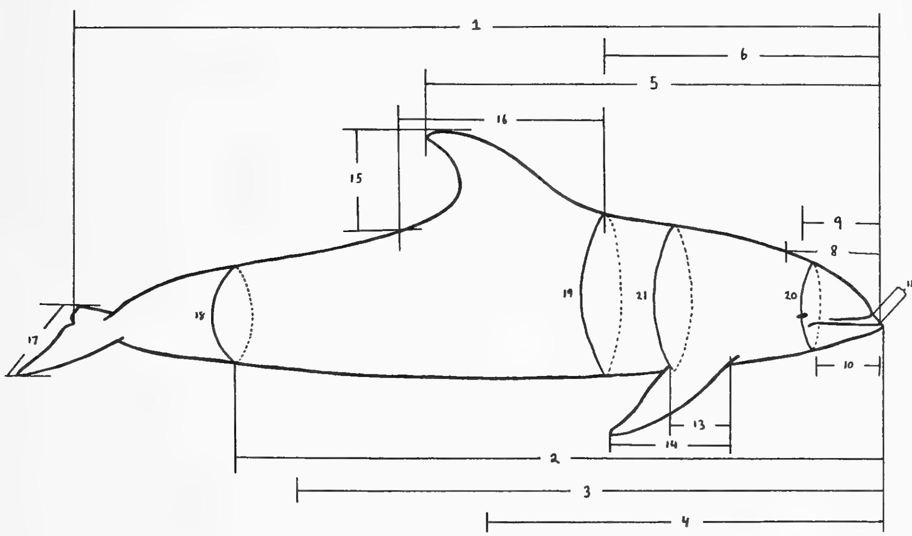


FIGURE 2. Measurements (in mm) of ice entrapped animals. 1) body length, tip of upper jaw to deepest part of fluke notch; 2) tip of lower jaw to centre of anus; 3) tip of lower jaw to centre of genital slit; 4) tip of lower jaw to centre of umbilicus; 5) tip of upper jaw to top of dorsal fin; 6) tip of upper jaw to leading edge of dorsal fin; 7) tip of upper jaw to anterior insertion of right flipper; 8) tip of upper jaw to anterior edge of blowhole; 9) tip of upper jaw to centre of right eye; 10) tip of upper jaw to angle of gape; 11) tip of upper jaw to apex of melon; 12) centre of eye to centre of eye, over top of head (not shown); 13) right flipper width at insertion; 14) right flipper length, tip to anterior insertion; 15) dorsal fin height; 16) dorsal fin base; 17) fluke span, tip to tip; 18) girth at anus; 19) girth at anterior dorsal; 20) girth at eye; 21) girth at axilla.

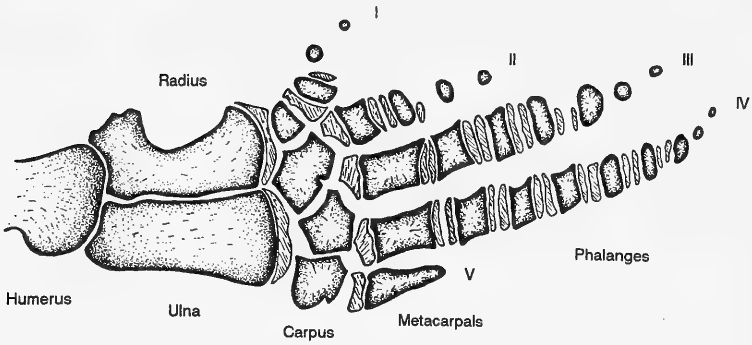


FIGURE 3. Pectoral fin measurements from x-rays.

that escaped or were killed beneath the ice is unknown. The animals at Point Verde and Placentia Arm were likely part of a larger group of dolphins which included the dolphins entrapped in ice at Black Point and Little Barasway, Placentia Bay on the same date (Table 1).

TABLE 1. Ice entrapments of White-beaked Dolphins (*Lagenorhynchus albirostris*) reported in Newfoundland (1979-1990).

| Date | Location | Details of entrapment |
|---|---|---|
| 1982 | | |
| 10 March | Port aux Basques | 40 dead; 35 examined |
| 1983 | | |
| 19 February | Chapel Arm, Trinity Bay | 3 alive, disappeared as ice receded. |
| 22 February | Bareneed, Conception Bay | 5-8 alive; dispeared as ice receded. |
| 24 February | Western Bay, Conception Bay | 20-30 alive; disappeared as ice receded; some believed to have died not examined. |
| 25 February | Ochre Pit Cove, Conception Bay | 20-30 alive; disappeared as ice receded, some dead, not examined. |
| 26 February | Adam's Cove | 1 dead; examined. |
| 3 March | Sunnyside, Trinity Bay | 3-4 alive; disappeared. |
| 6 March | Old Shop, Trinity Bay | 8 alive; disappeared. |
| 8 March | Whiteaway, Trinity Bay | 8-10 alive; died in ice, not examined. |
| 24 March | Fairhaven, Placentia Bay | 15-20 alive; 6 collected alive; rest disappeared as ice receded; not examined. |
| 24 March | Mt. Carmel, St. Mary's Bay | 4 alive; disappeared as ice receded. |
| 25 March | Point Verde, Placentia Bay | 68 alive; 20 killed; remainder died in ice; 26 examined. |
| 1984 | | |
| 25 March | Placentia Arm, Placentia Bay | 100 alive; pressure on ice; 26 found dead on beach; 14 examined. |
| 25 March | Black Point, Placentia Bay | 20-30 alive, disappeared. |
| 27 March | Little Barasway, Placentia Bay | 1 dead |
| 1987 | | |
| 8 April | Lawn, Placentia Bay | 8-12 alive in ice for 24 hrs.; observed; disappeared - believed dead; not examined; 4 found 4 July. |
| 22 April | Little Bay East, Fortune Bay | 2-3 in ice alive, disappeared as ice receded. |
| 11 April | Hant Harbour, Trinity Bay | 6 dead; not examined. |
| 1989 | | |
| 20 February | Torbay | 3 alive, disappeared in ice. |
| 1990 | | |
| 6 February | Jamestown | 6-8 dead; not examined |
| 3 March | Rencontre East | 6-8 dead; not examined |

TABLE 2. Strandings of White-beaked Dolphins (*Lagenorhynchus albirostris*) reported in Newfoundland (1979-1990).

| Date | Location | Details of entrapment |
|---|---|---|
| 20 May 1983 | Point Lance | 7 dead; not examined. |
| 13 September 1985 | Point Leamington, Notre Dame Bay | 2 dead; not examined. |
| 2 July 1986 | Point La Haye | Dead female + foetus; died in birth; examined. |
| 25 August 1986 | Stephenville | 3 dead; believed same animals caught by fisherman; not examined. |
| 14 September 1987 | Lewisport | 3 animals stranded alive; pulled from beaches; disappeared; not examined. |
| 31 March 1988 | St. Shotts | Male stranded alive; killed; examined. |
| 1 March 1989 | Point Lance | Dead; not examined. |
| 20 July 1989 | Sandy Point, Port au Port | 4 alive; pushed out; disappeared. |
| 27 July 1989 | Black Bank Beach | Dead; believe one from 20 July; not examined. |

Autopsies on 26 dolphins were performed at Point Verde on 25 March. Investigators returned on 26 March but ice had scoured the beach clean overnight and no animals remained. Seventeen of the 24 dolphins trapped in Placentia Arm were also examined. All autopsies were completed by the afternoon of 26 March.

*Field Examinations*

The harsh field conditions under which the dolphins were examined limited the collection of data. Complete morphometric data were taken for each animal when possible (Tables 4 and 5, Figure 2). Stomach contents, the lower jaw, a flipper and the sex organs were also collected for laboratory examination.

*Laboratory Examinations*

The ages of dolphins were estimated from longitudinal and cross-sections of the teeth. Two large teeth were removed from each jaw. One tooth was cut into longitudinal sections and the other cross-sectioned at the gum line. The sections were polished to a 25 micron thickness and decalcified with a 10% formic acid soak. The sections were then stained for 40 minutes in Mayer's haematoxylin, rinsed, dehydrated in alcohol, mounted on slides and examined with a 40 power microscope with ground illumination.

The flippers from animals for which teeth were also available were frozen and x-rayed. The x-rays were examined to determine the degree of fusion of the bones (Figure 3). The bones examined for fusion included the humerus, radius, ulna, and the bones of the five phalanges. Fusion of the humerus, radius and ulna were rated on a five step scale with step one representing no fusion and step five representing complete fusion. The number of steps in the fusion scales for the phalanges varied with the number of bones examined in each phalange; for each case, the first step represented little or no fusion and the last step complete fusion.

Non-linear regressions for body length and age, and body length and flipper length were performed separately for males and females. The average body lengths corresponding to physical maturity for each sex were entered into the regression equations and average ages of physical maturity calculated.

The stomach contents were weighed and sorted. Identification of food items and parasites were identified by comparison with the otolith and parasite collections at the Memorial University of Newfoundland.

## Results and Discussion

*Ice Entrapments*

Ice entrapments of White-beaked Dolphins occurred regularly in years when pack ice was heavy and was widely distributed over most of the coastline of Newfoundland (Table 1, Figure 1). Twenty-one ice entrapments were reported from 1979 to 1991 involving a total of 320 to 350 animals. Known mortality as a result of ice entrapment was about 55%. However, actual mortality may have been higher as 17 to 21% of the dolphins disappeared in the pack ice, and it is likely that some of them died. Only 24 to 28% of the dolphins reported ice entrapped were known to have survived.

Ice entrapped groups of dolphins ranged in size from two to three individuals to several hundred ani-

TABLE 3. Incidental entrapments of White-beaked Dolphins (*Lagenorhynchus albirostris*) in inshore fishing gear reported in Newfoundland (1979-1990).

| Date | Location | Details of entrapment |
|---|---|---|
| 21 August 1987 | Frenchman's Cove, Fortune Bay | Dead; caught in groundfish gillnet. |
| 30 March 1988 | Holyrood, Conception Bay | Dead; caught in herring gillnet. |
| 25 June 1988 | Bauline, Conception Bay | 2 dead; caught in codtrap. |

TABLE 4. Measurements and ages of ice-entrapped White-beaked Dolphins from Port-aux-Basques. Measurements codes are estimated in Figure 2.

| ID# | Sex | Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PB1 | F | 2 | 2240 | 1620 | 1530 | 1400 | 1390 | 960 | 480 | 300 | 305 | 240 | 50 | 440 | 170 | 425 | 250 | 260 | 260 | 840 | 1360 | 870 | 1340 |
| PB2 | F | 7 | 1620 | 1530 | 1400 | 1480 | 960 | 960 | | 320 | | 235 | 40 | 480 | 180 | 450 | 240 | 320 | 580 | 902 | 1460 | 900 | 1384 |
| PB3 | F | 2 | | | | | | | | | | | | | | | | | | | | | |
| PB4 | F | 4 | 2210 | | | | | | | | | | | | | | | | | | | | |
| PB5 | F | 2 | 1960 | 1395 | 1280 | 905 | 1290 | 900 | 450 | 285 | 285 | 225 | 45 | 420 | 110 | 360 | 215 | 330 | 460 | 695 | 1256 | 820 | 1160 |
| PB6 | M | 2 | 2100 | 1490 | 1260 | 970 | 1350 | 922 | 470 | 305 | | 240 | 50 | 440 | 170 | 385 | 215 | 360 | 430 | 820 | 1390 | 835 | 1240 |
| PB7 | | 3 | | | | | | | | | | | | | | | | | | | | | |
| PB8 | F | 3 | 2250 | 1610 | 1530 | 1400 | 1420 | 950 | | 335 | | 240 | 55 | 445 | 183 | 422 | 255 | 410 | 490 | 880 | 1380 | 865 | 1250 |
| PB9 | F | 2 | 2035 | 1448 | 1349 | 946 | 1365 | 914 | 419 | 305 | 289 | 222 | 50 | 445 | 165 | 406 | 229 | 406 | 483 | 819 | 1276 | 826 | 1136 |
| PB10 | F | 5 | 2210 | 1632 | 1524 | 1035 | 1464 | 1016 | 470 | 337 | 311 | 235 | 55 | 470 | 184 | 438 | 229 | 445 | 511 | 851 | 1372 | 914 | 1270 |
| PB11 | F | 2 | 1530 | 1422 | 984 | 1470 | 1003 | 460 | 318 | 305 | 241 | 55 | | 175 | 419 | 251 | 406 | 483 | 797 | 1356 | 914 | 1282 | |
| PB12 | F | 2 | 2020 | 1450 | 1380 | 950 | 1370 | 910 | 440 | 296 | 292 | 230 | 45 | 410 | 172 | 360 | 220 | 400 | 400 | 735 | 1250 | 835 | 1300 |
| PB13 | M | 2 | 2073 | 1483 | 1257 | 965 | 1384 | 902 | | 314 | 292 | 229 | 45 | | 178 | 406 | 241 | 368 | 514 | 819 | 1422 | 879 | 1320 |
| PB14 | | 3 | | | | | | | | | | | | | | | | | | | | | |
| PB15 | M | 3 | 2184 | 1610 | 1346 | 1029 | 1473 | 965 | 464 | 314 | 308 | 251 | 50 | 457 | 178 | 416 | 225 | 387 | 498 | 845 | 1398 | 902 | 1366 |
| PB16 | F | 4 | | | | | | | | | | | | | | | | | | | | | |
| PB17 | F | 3 | 2127 | 1524 | 1429 | 981 | 1353 | 933 | 448 | 302 | 302 | 232 | 48 | 438 | 184 | 406 | 244 | 406 | 470 | 781 | 1346 | 867 | 1270 |
| PB18 | M | 4 | 2337 | 1711 | 1435 | 1092 | 1553 | 1016 | 483 | 330 | 321 | 254 | 52 | 492 | 203 | 470 | 286 | 495 | 600 | 902 | 1460 | 927 | 1436 |
| PB19 | M | 3 | 2045 | 1461 | 1238 | 956 | 1340 | 940 | 425 | 308 | 292 | 232 | 47 | 454 | 168 | 397 | 241 | 381 | 495 | | | 864 | |
| PB20 | M | 3 | 2159 | 1499 | 1251 | 940 | 1448 | 1016 | 438 | 311 | 298 | 235 | 50 | 454 | 171 | 406 | 238 | 368 | 489 | 775 | 1244 | 864 | 1168 |
| PB21 | F | 3 | 2146 | 1473 | 1375 | 953 | 1486 | 1003 | 451 | 314 | 292 | 229 | 50 | 445 | 181 | 419 | 251 | 381 | 505 | | | 889 | |
| PB22 | F | 3 | 2045 | 1410 | 1321 | 914 | 1346 | 889 | 419 | 292 | | 216 | 50 | 438 | 159 | 368 | 238 | 406 | 464 | 759 | 1244 | 828 | 1118 |
| PB23 | F | 3 | 2089 | | | | | | | | | | | | | | | | | | | | |
| PB24 | M | 3 | 2083 | 1473 | 1381 | 953 | 1359 | 921 | 432 | 314 | 292 | 229 | 50 | 438 | 178 | 406 | 235 | 400 | 483 | 756 | 1290 | 851 | 1238 |
| PB25 | M | 2 | 2140 | 1518 | 1270 | 981 | 1441 | 933 | 432 | 311 | 292 | 229 | 50 | 457 | 191 | 429 | 254 | 406 | 521 | 775 | 1384 | 851 | 1320 |
| PB26 | F | 3 | 2096 | 1483 | 1397 | 975 | 1365 | 902 | 432 | 311 | 295 | 229 | 53 | 441 | 178 | 416 | 244 | 394 | 470 | 762 | 1290 | 895 | 1282 |
| PB27 | F | 2 | 1994 | 1451 | 1353 | 933 | 1372 | 914 | 432 | 305 | 286 | 225 | 46 | 435 | 165 | 387 | 244 | 381 | 502 | 778 | 1358 | 857 | 1320 |
| PB28 | M | 2 | 1892 | 1372 | 1143 | 895 | 1289 | 895 | 406 | 279 | 264 | 213 | 43 | 419 | 165 | 368 | 216 | 362 | 460 | 737 | 1244 | 826 | 1232 |
| PB29 | M | | 2318 | | | | | | | | | | | | | | | | | | | | |
| PB30 | M | | | | | | | | | | | | | | | | | | | | | | |
| PB31 | F | 2 | 2042 | | | | | | | | | | | | | | | | | | | | |
| PB32 | F | 3 | 2159 | | | | | | | | | | | | | | | | | | | | |
| PB33 | M | 3 | 2200 | | | | | | | | | | | | | | | | | | | | |
| PB34 | F | 2 | 2007 | | | | | | | | | | | | | | | | | | | | |
| PB35 | F | 3 | 2149 | | | | | | | | | | | | | | | | | | | | |
| PB36 | M | 5 | 2407 | | | | | | | | | | | | | | | | | | | | |

TABLE 5. Measurements and estimated ages of ice-entrapped White-beaked Dolphins from Placentia Bay. Measurement codes are estimated in Figure 2.

| ID# | Sex | Age | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PV1 | F | 1 | 1790 | 1230 | | 810 | | 860 | 390 | 280 | 250 | 210 | | | 120 | 330 | 210 | 280 | 400 | | | | |
| PV2 | M | 1 | 1680 | 1140 | | 770 | | 760 | 390 | 270 | 250 | 190 | | | 150 | 340 | 190 | 280 | 370 | | | | |
| PV3 | M | 1 | 1750 | 1100 | | 840 | | 760 | 400 | 270 | 240 | 200 | | | 140 | 320 | 170 | 270 | 350 | | | | |
| PV4 | F | 16 | 2450 | 1650 | | 1030 | | 1060 | 460 | 340 | | 240 | | | 190 | 480 | 340 | 420 | 650 | | | | |
| PV5 | F | 15 | 3050 | 1790 | | 950 | | 1200 | 520 | 360 | 320 | 250 | | | 200 | 470 | 350 | 410 | | | | | |
| PV6 | F | 1 | 1850 | 1250 | | 820 | | 830 | 410 | 280 | 270 | 210 | | | 140 | 330 | 210 | 280 | 420 | | | | |
| PV7 | F | 13 | 2520 | 1730 | | 450 | | 650 | | 330 | 300 | 240 | | | | | | | 660 | | | | |
| PV8 | F | 13 | 2480 | 1630 | | 1010 | | | 440 | 340 | | 260 | | | | 450 | | | 610 | | | | |
| PV9 | F | 13 | 2430 | | | | | | | | | | | | | | | | 640 | | | | |
| PV10 | F | 11 | 2590 | | | | | | | | | | | | | | | | | | | | |
| PV11 | F | | 2400 | | | | | | | | | | | | | | | | | | | | |
| PV12 | F | 13 | 2630 | | | | | | | | | | | | | | | | | | | | |
| | (M) | | 920 | | | | | | | | | | | | | | | | | | | | |
| PV13 | F | 1 | 2040 | | | | | | | | | | | | | | | | | | | | |
| PV14 | F | 1 | | | | | | | | | | | | | | | | | | | | | |
| PV15 | | | 1810 | | | | | | | | | | | | | | | | | | | | |
| PV16 | F | 1 | 1790 | | | | | | | | | | | | | | | | | | | | |
| PV17 | F | 15 | 2630 | | | | | | | | | | | | | | | | | | | | |
| PV18 | M | 13 | 2700 | | | | | | | | | | | | | | | | | | | | |
| PV19 | F | 1 | 2150 | | | | | | | | | | | | | | | | | | | | |
| PV20 | M | 13 | 2810 | | | | | | | | | | | | | | | | | | | | |
| PV21 | F | 12 | 2660 | | | | | | | | | | | | | | | | | | | | |
| PV22 | F | 1 | 2150 | | | | | | | | | | | | | | | | | | | | |
| PV23 | | 1 | 2110 | | | | | | | | | | | | | | | | | | | | |
| PV24 | | 1 | 1760 | | | | | | | | | | | | | | | | | | | | |
| PV25 | M | | 1910 | | | | | | | | | | | | | | | | | | | | |
| PV26 | F | 1 | 1740 | | | | | | | | | | | | | | | | | | | | |
| | (F) | | | | | | | | | | | | | | | | | | | | | | |
| PV27 | M | | | | | | | | | | | | | | | | | | | | | | |
| PV28 | M | 8 | 2580 | | | | | | | | | | | | | | | | | | | | |
| PV29 | M | 9 | 2090 | | | | | | | | | | | | | | | | | | | | |
| PV30 | F | 7 | 2480 | | | | | | | | | | | | | | | | | | | | |
| PV31 | F | | 2000 | | | | | | | | | | | | | | | | | | | | |
| PV32 | M | 1 | 1820 | | | | | | | | | | | | | | | | | | | | |
| PV33 | F | | 2110 | | | | | | | | | | | | | | | | | | | | |
| PV34 | M | 12 | 2820 | | | | | | | | | | | | | | | | | | | | |
| PV35 | (M) | | 890 | | | | | | | | | | | | | | | | | | | | |
| PV36 | F | | 2460 | | | | | | | | | | | | | | | | | | | | |
| PV37 | M | 13 | 2840 | | | | | | | | | | | | | | | | | | | | |
| PV38 | M | 12 | 2770 | | | | | | | | | | | | | | | | | | | | |
| PV39 | F | 11 | 2560 | | | | | | | | | | | | | | | | | | | | |
| | (M) | | 940 | | | | | | | | | | | | | | | | | | | | |
| PV40 | F | 7 | 2450 | | | | | | | | | | | | | | | | | | | | |
| | (F) | | 790 | | | | | | | | | | | | | | | | | | | | |

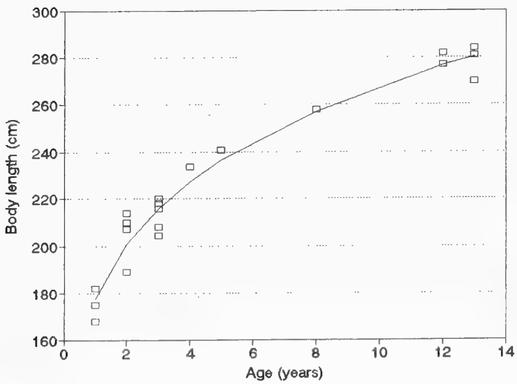


FIGURE 4. Relationship between age and body length in male White-beaked Dolphins (*Lagenorhynchus albirostris*).

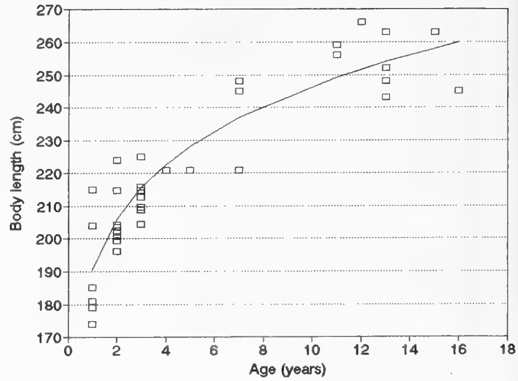


FIGURE 5. Relationship between age and body length in female White-beaked Dolphins (*Lagenorhynchus albirostris*).

mals. Occasionally, single ice-entrapped dolphins were also reported; these were probably the remnants of unobserved group entrapments. Similarly, early spring discoveries of groups of relatively fresh dead dolphins (e.g., the May 1983 stranding at Point Lance) were probably the result of unobserved ice entrapments (Lien et al. 1983).

*Strandings*

Strandings of White-beaked Dolphins which were not known to have been entrapped or driven ashore by ice are shown in Table 2 and Figure 1. A total of nine strandings were reported; five of these involved groups of animals. There were three strandings of live animals. None of these dolphins were measured or autopsied.

*Entrapments in Fishing Gear*

Very few White-beaked Dolphins were reported as incidentally caught in fishing gear (Table 3) but these data probably under-estimate actual catches. The incidental capture of dolphins by inshore fishermen in Newfoundland and Labrador is common (Lien et al. 1994); however, since dolphin entrapments generally cause little gear damage and the dolphins are frequently eaten, fishermen have little motivation to report these catches (Lien et al. 1994; Lien 1994).

*Observations of Ice-entrapped Dolphins*

Many of the dolphins from both the Port-aux-Basques and Point Verde ice entrapments had severe scrapes and cuts from the ice. The beaks and heads of many dolphins had been abraded when the head was pushed between ice pans into the air to breathe. Bloody froth was typically found in the lungs. Six animals had liver ruptures, serious abdominal bleeding or broken ribs. One had a deep gash on its side and a ruptured stomach. These injuries were caused by crushing between ice pans. Except for the animals which were euthanized by gunshot, the immediate cause of death for most of the dolphins was not apparent.

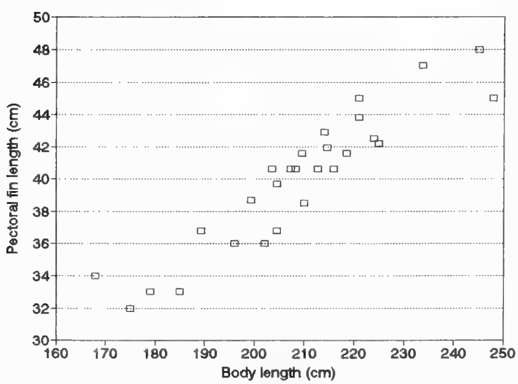


FIGURE 6. Relationship between body length and flipper length in White-beaked Dolphins (*Lagenorhynchus albirostris*).

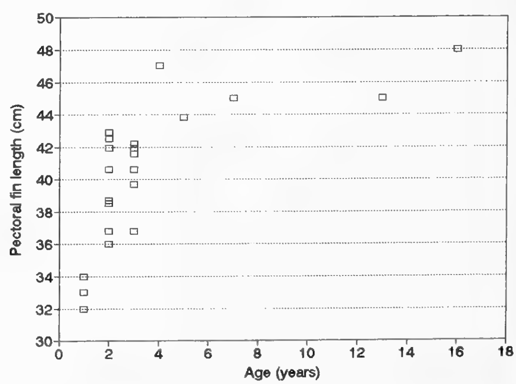


FIGURE 7. Relationship between age and flipper length in White-beaked Dolphins (*Lagenorhynchus albirostris*).

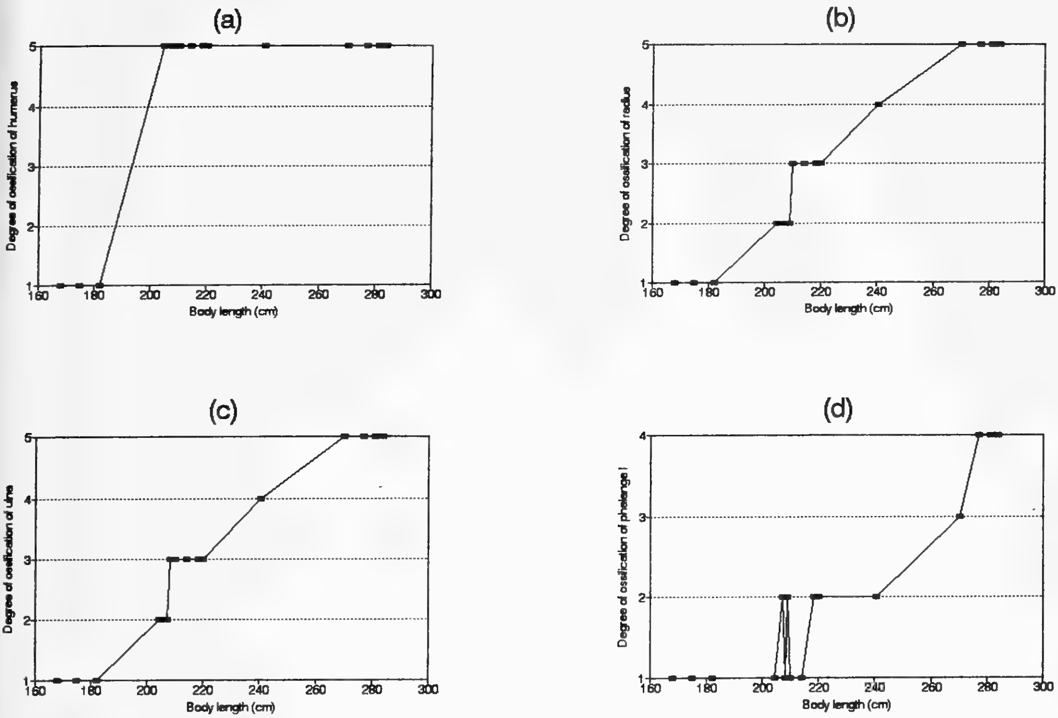


FIGURE 8. Relationship between the degree of fusion in the flippers and body length in male White-beaked Dolphins (*Lagenorhynchus albirostris*). The bones in the flippers are labelled as follows: (a) humerus; (b) radius; (c) ulna; (d) phalange I.

*Morphometric Measurements and Estimated Ages*

Measurements taken from the ice-entrapped dolphins are presented in Tables 4 and 5. Longitudinal tooth sections provided the most reliable means of estimating age (Tables 4 and 5). A narrow layer of uniform dentine in the section ended in a distinct clear line; this was identified as the neonatal line (GLG). The first postnatal GLG was wider than subsequent layers which were regularly spaced but declined in width toward the pulp cavity. Between 15-17 GLGs were found in the teeth before the pulp cavity was filled; these layers were more difficult to "read". GLGs beyond the first postnatal layer were assumed to be deposited annually.

The ice-entrapped dolphins at Port-aux-Basques were primarily young animals with lengths ranging from 189-241 cm (n = 31, mean length = 213 cm, s.d. = 11 cm) and estimated ages from two to seven years (n = 34, mean age = 2.9 years, s.d. = 1.1 years). Most of the dolphins were two to three years of age. The group of dolphins entrapped at Point Verde ranged in length from 168 to 305 cm (n = 37, mean length = 229 cm, s.d. = 39 cm). Thirteen of the Point Verde animals were one year old; the remaining fifteen were adults more than six years old (n = 15, mean age = 11.9 years, s.d. = 2.6 years).

The dolphins grew quickly prior to three years of age (Figures 4 and 5). Males showed a different growth pattern from females in that they grew at a faster rate and tended to be larger than females after reaching about three years of age. Morphometric data for the two sites were combined and non-linear regressions between age and length were performed for both sexes. The results were as follows:

Females:
Body length (cm) = 191 * [Age (years)]$^{0.112}$
($r^2$=0.81, df=36, $p$<0.01)

Males:
Body length (cm) = 177 * [Age (years)]$^{0.179}$
($r^2$=0.96, df=18, $p$<0.01)

Figures 6 and 7 show the relationships between flipper length, body length and estimated age. Using morphometric data from both ice-entrapment sites, non-linear regressions were performed between flipper length and body length, and flipper length and age. The results are listed below:

Flipper length (cm) = 35.5 * [Age (years)]$^{0.126}$
($r^2$=0.67, df=26, $p$<0.01)

Flipper length (cm) = 0.128 * [Body length (cm)]$^{1.08}$
($r^2$=0.88, df=26, $p$<0.01)

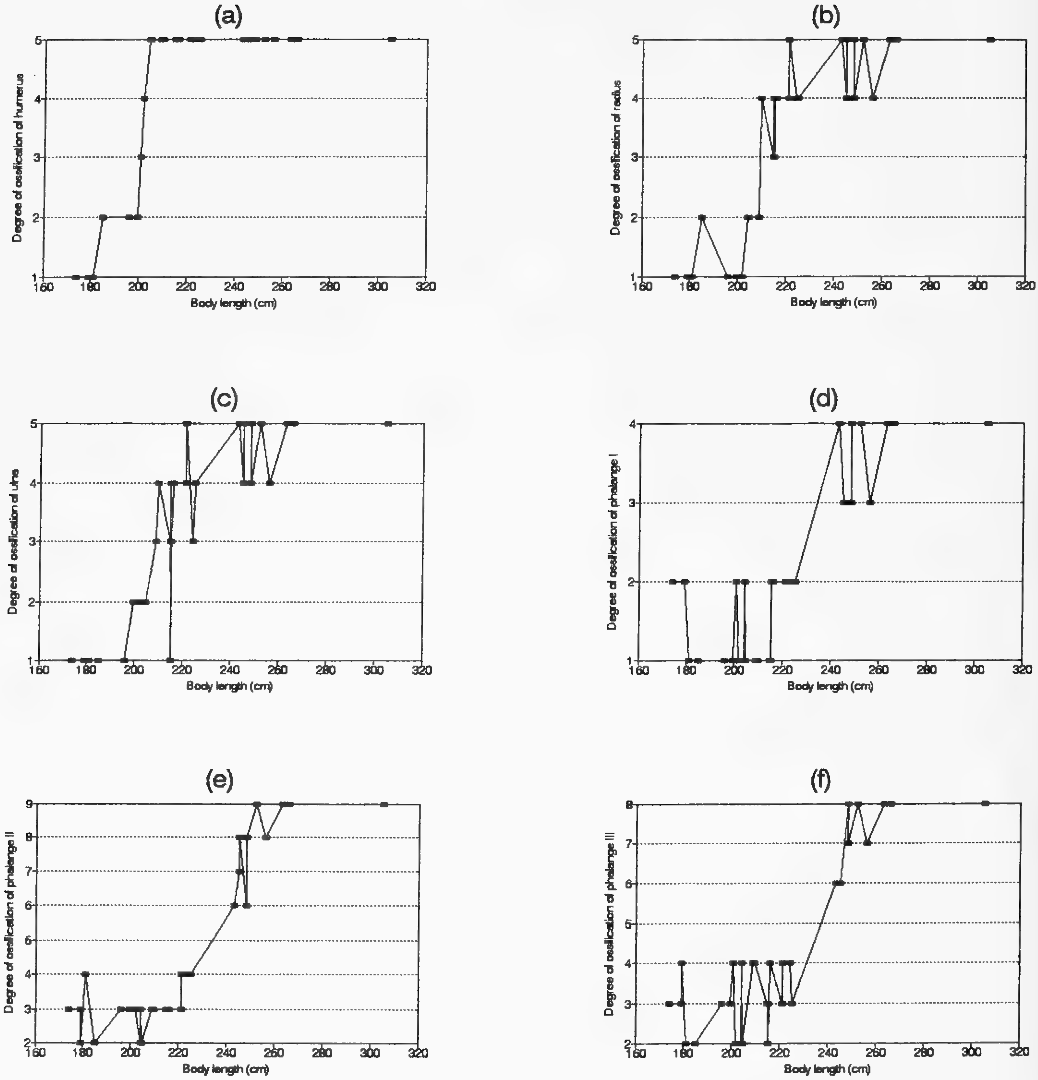


FIGURE 9. Relationship between the degree of fusion in the flippers and body length in female White-beaked Dolphins (*Lagenorhynchus albirostris*). The bones in the flippers are labelled as follows: (a) humerus; (b) radius; (c) ulna; (d) phalange I; (e) phalange II; (f) phalange III.

Four of the 24 female dolphins from Point Verde were pregnant. The youngest of these animals was one year old and 174 cm long; as this is improbable it is likely an error in field recording. The remaining three were at least seven years old and 245 cm long. None of the female animals at the Port-aux-Basques stranding were pregnant. There was insufficient data to determine the average body length and age corresponding to sexual maturity.

The degrees of fusion of all of the bones in the flippers increased with age for both sexes (Figures 8 and 9). The humerus was the first bone in the flippers to show complete fusion, followed by the radius and ulna, and finally by the five phalanges.

Since the phalanges were the last bones in the flippers to fuse completely, physical maturity was defined as the average body length corresponding to the fusion of these bones. By this criterion, four male and four female animals were considered physically mature. On average, male White-beaked Dolphins become physically mature at a length of 281 cm (s.d. = 2.9 cm), which corresponds to an age of 13 years; females dolphins achieve physical maturity at an average body

length of 261 cm (s.d. = 6.2 cm), corresponding to an age of 16 years.

These results also indicated sexual dimorphism in White-beaked Dolphins. A t-test showed that mature males had significantly greater body lengths than female animals ($t = 5.86$, $df = 6$, $p<0.01$).

*Stomach Contents*

Stomachs from all animals in the Port-aux-Basques entrapment were infested with worms (*Anisakis* spp.). Contents of the stomachs of 20 Port-aux-Basques animals were examined; the stomachs of the remaining animals were empty. The mass of food in the stomachs varied from 10.5-446.0 g with a mean mass of 122 g. Most of the animals (90%) had otoliths and bones from cod (*Gadus morhua*) in their stomachs although there was no flesh or other indications of recent feeding. In general, the largest otoliths came from the stomachs of the largest animals. A few of the stomachs (10%) contained remnants of crab (*Chionoecetes opilio*) and seaweed. Four stomachs (20%) contained fish hooks from trawls which are commonly used in the area to catch cod. Stomachs from the Point Verde animals were not collected.

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# Identification of Greater Scaup, *Aythya marila*, and Lesser Scaup, *A. affinis*, Ducklings

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Nelson, Colleen H. 1996. Identification of Greater Scaup, *Aythya marila*, and Lesser Scaup, *A. affinis*, ducklings. Canadian Field-Naturalist 110(2): 288–293.

Both relative size and the nail-width described by earlier authors will distinguish the Greater Scaup (*Aythya marila*) from the Lesser Scaup (*A. affinis*) at all ages. These criteria are most useful if the age of the scaup is known. In this study, an attempt was made to obtain a nearly constant ratio that would identify the two species with some degree of certainty regardless of age, sex, or condition. Checked on live specimens from Canada and on museum specimens from North America, this ratio was found to be 90% effective.

Key Words: Greater Scaup, *Aythya marila*, Lesser Scaup, *Aythya affinis*, ducklings, identification.

Both Palmer (1976) and Todd (1963) described ways of distinguishing between Greater Scaup and Lesser Scaup. Although both ways are correct, they work best if the exact age of the specimen is known. The exact age of specimens in the field, however, is seldom known. Therefore, while the work of both Palmer (1976) and Todd (1963) has been confirmed in this study, the search continued for a ratio that would separate ducklings of Greater Scaup from ducklings of Lesser Scaup at all times.

## Materials and Methods

Employing a steel caliper, I used the chordal measurements of Baldwin et al. (1931) and the sexing method of Hochbaum (1942). In 1972, I made a measured pencil drawing, 2x life size, of the bill of each species each day, from inidividuals chosen at random; a selection of these drawings comprises Figure 1.

All birds were weighed each day until the capacity of the triple-beam balance was reached. Thereafter, the birds were weighed on appropriate Pesola balances. A database was made for the eight Manitoba Greater Scaup and the 22 Manitoba Lesser Scaup. All measurements of weight or mass are in grams and all linear measurements are in centimetres.

Unless otherwise indicated, all Greater Scaup discussed herein belong to the subspecies, *nearctica* Stejneger, following Banks (1986).

## Results

The size differences described by Palmer (1976) are indicated in Table 1 by increased weight or mass (WT) and length of exposed culmen (EC). Todd's (1963) nail-width character is expressed in Table 1 as a percentage of bill-width: WN/WB. Although the percentages do not decrease as dramatically as in goldeneyes described by Nelson (1993a), they do eventually decrease, going from 0.46 (age A) down to 0.30 (age E) in the Manitoba Greater Scaup and from 0.43 (age A) down to 0.27 (age E) in the Manitoba Lesser Scaup.

Subsequently, various ratios were tested. A three-part ratio, (WN x LN)/HBB, proved useful in distinguishing Greater Scaup from Lesser Scaup. The ratio was used to separate scaup of both species from all areas (Nelson 1993b). The ratio is usually 0.3 or above for live Manitoba Greater Scaup and usually below 0.3 for live Manitoba Lesser Scaup (Table 2). This ratio was checked on live Manitoba and Saskatchewan Lesser Scaup in 1974 and 1977, and on live Northwest Territories Greater Scaup in 1983 (Table 3). These data differed significantly between Lesser Scaup and Greater Scaup, with a confidence level of 90% or more (t-test). Table 4 includes live, known-age scaup of both species and of separate sexes. The identification ratio was further checked on museum specimens of estimated age (Table 5).

## Discussion

There is a size difference in some *Aythya* species. Usually, males are larger than females (Hochbaum 1944; Weller 1957), the opposite is true in the scaup. This difference becomes apparent when ducklings are about 10 days old. However, when the sexes are lumped, all Greater Scaup are larger than all Lesser Scaup (Table 4; Palmer 1976), including age A birds.

Scaup of both species show considerable individual size variation whether or not the breeding ranges of the two species overlap. It is important to note that scaup of both species were larger in 1974, 1977, and 1983, than either species was in 1972. This variation sometimes means that birds of both species may be larger in one location than in another. The

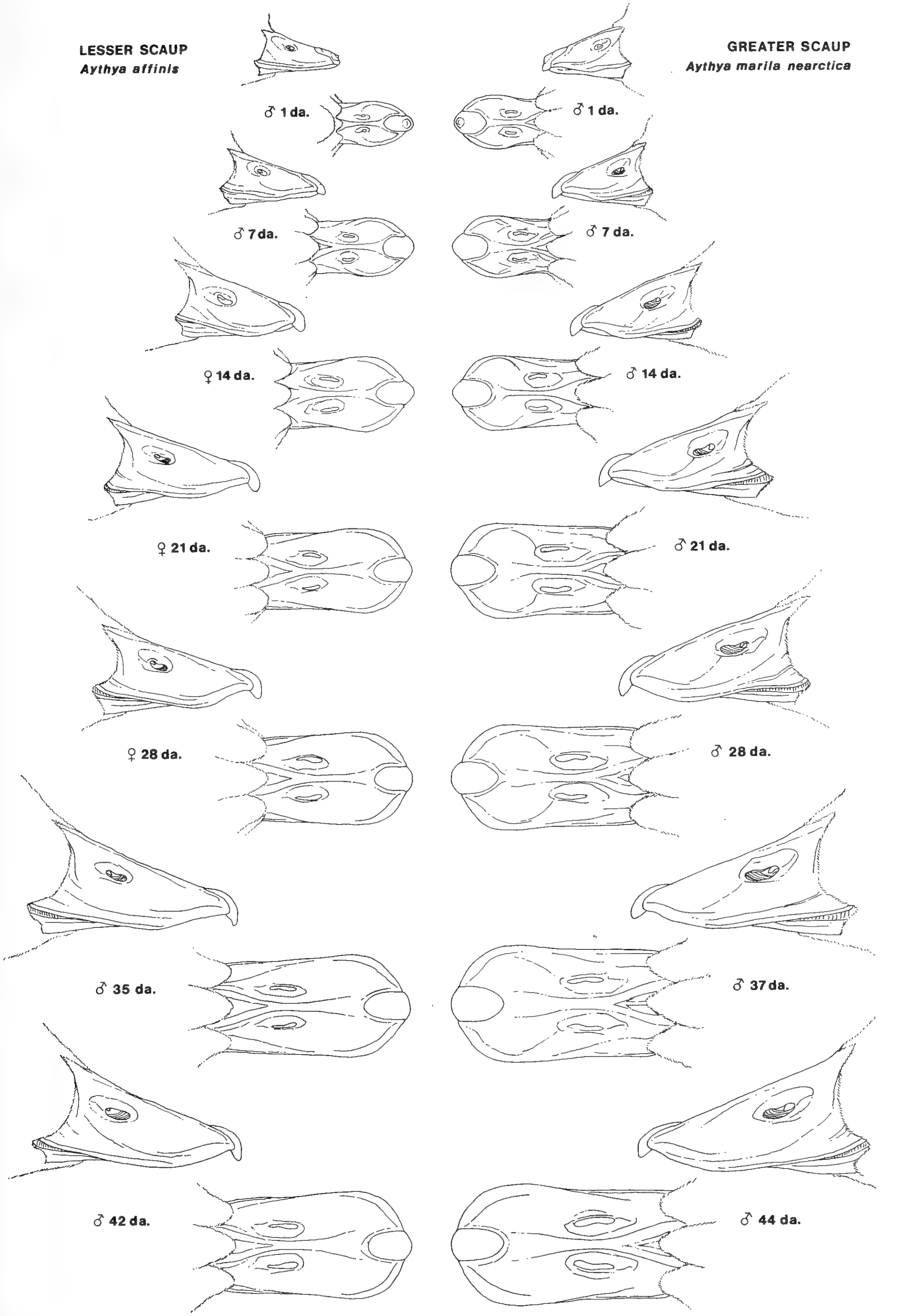


FIGURE 1. Comparison of bills of ducklings of Lesser Scaup and Greater Scaup from 1 to 40+ days.

TABLE 1. Comparative measurements of live, known-age captives from Manitoba (1972). Live birds are lumped as follows: age A = days 1–5, age B = days 6–10, age C = days 11–15, age D = days 16-20, age E = day 21 and older. EC = exposed culmen; WN = width of nail; WB = width of bill; and WT = weight or mass.

| Species / Origin / Parameter / Age | Sample | Range | Mean | S.D. | S.E. |
|---|---|---|---|---|---|
| *A. m. nearctica* | | | | | |
| Churchill, Manitoba | | | | | |
| EC | | | | | |
| A | 40 | 1.50 - 1.96 | 1.72 | 0.110 | 0.017 |
| B | 39 | 1.75 - 2.39 | 2.06 | 0.140 | 0.026 |
| C | 40 | 2.17 - 2.86 | 2.50 | 0.170 | 0.027 |
| D | 37 | 2.62 - 3.23 | 2.92 | 0.150 | 0.024 |
| E | 77 | 2.95 - 4.36 | 3.50 | 0.350 | 0.040 |
| WN | | | | | |
| A | 40 | 0.47 - 0.60 | 0.54 | 0.036 | 0.006 |
| B | 40 | 0.53 - 0.58 | 0.55 | 0.012 | 0.002 |
| C | 40 | 0.53 - 0.58 | 0.55 | 0.013 | 0.002 |
| D | 40 | 0.54 - 0.61 | 0.57 | 0.018 | 0.003 |
| E | 79 | 0.57 - 0.72 | 0.62 | 0.033 | 0.004 |
| WN/WB | | | | | |
| A | 40 | 0.42 - 0.54 | 0.46 | 0.024 | 0.004 |
| B | 40 | 0.34 - 0.47 | 0.41 | 0.027 | 0.004 |
| C | 40 | 0.32 - 0.40 | 0.36 | 0.021 | 0.003 |
| D | 39 | 0.30 - 0.35 | 0.32 | 0.012 | 0.002 |
| E | 79 | 0.24 - 0.33 | 0.30 | 0.012 | 0.002 |
| WT | | | | | |
| A | 40 | 37.30 - 64.20 | 47.49 | 6.030 | 0.953 |
| B | 40 | 56.90 - 112.90 | 79.15 | 13.240 | 2.093 |
| C | 40 | 86.40 - 181.80 | 121.21 | 23.810 | 3.764 |
| D | 40 | 124.30 - 286.30 | 193.97 | 38.650 | 6.111 |
| E | 80 | 174.20 - 707.20 | 337.16 | 129.550 | 14.484 |
| *A. affinis* | | | | | |
| Shoal Lake, Manitoba | | | | | |
| EC | | | | | |
| A | 82 | 1.25 - 1.70 | 1.46 | 0.103 | 0.011 |
| B | 79 | 1.53 - 2.20 | 1.83 | 0.156 | 0.017 |
| C | 76 | 1.86 - 2.70 | 2.28 | 0.188 | 0.022 |
| D | 74 | 2.27 - 5.65 | 2.71 | 0.387 | 0.050 |
| E | 154 | 2.60 - 4.11 | 3.27 | 0.342 | 0.027 |
| WN | | | | | |
| A | 86 | 0.34 - 0.50 | 0.42 | 0.034 | 0.004 |
| B | 80 | 0.41 - 0.52 | 0.46 | 0.030 | 0.003 |
| C | 76 | 0.41 - 0.54 | 0.47 | 0.030 | 0.003 |
| D | 68 | 0.42 - 0.56 | 0.48 | 0.030 | 0.003 |
| E | 163 | 0.44 - 0.58 | 0.51 | 0.027 | 0.002 |
| WN/WB | | | | | |
| A | 86 | 0.35 - 0.53 | 0.43 | 0.032 | 0.003 |
| B | 80 | 0.32 - 0.43 | 0.38 | 0.028 | 0.003 |
| C | 76 | 0.26 - 0.37 | 0.33 | 0.024 | 0.002 |
| D | 71 | 0.25 - 0.34 | 0.29 | 0.020 | 0.002 |
| E | 155 | 0.23 - 0.31 | 0.27 | 0.018 | 0.001 |
| WT | | | | | |
| A | 85 | 26.00 - 53.40 | 35.17 | 6.033 | 0.654 |
| B | 80 | 37.80 - 122.90 | 69.54 | 19.636 | 2.195 |
| C | 76 | 57.20 - 190.90 | 121.75 | 26.396 | 3.028 |
| D | 74 | 106.60 - 273.80 | 184.46 | 33.810 | 3.930 |
| E | 165 | 165.20 - 553.50 | 327.89 | 98.952 | 7.703 |

TABLE 2. Identification ratio, (WNxLN)/HBB, for live, known-age captives from Manitoba (1972). LN = length of nail and HBB = height of bill at base. Ages as in Table 1.

| Species / Origin / Parameter / Age | Sample | Range | Mean | S.D. | S.E. |
|---|---|---|---|---|---|
| *A. m. nearctica* | | | | | |
| Churchill, Manitoba | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 40 | 0.30 - 0.38 | 0.34 | 0.020 | 0.003 |
| B | 40 | 0.29 - 0.35 | 0.32 | 0.015 | 0.002 |
| C | 40 | 0.28 - 0.34 | 0.31 | 0.014 | 0.003 |
| D | 39 | 0.27 - 0.34 | 0.30 | 0.016 | 0.003 |
| E | 76 | 0.28 - 0.35 | 0.31 | 0.016 | 0.002 |
| *A. affinis* | | | | | |
| Shoal Lake, Manitoba | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 66 | 0.18 - 0.34 | 0.26 | 0.032 | 0.004 |
| B | 72 | 0.21 - 0.31 | 0.26 | 0.018 | 0.002 |
| C | 76 | 0.21 - 0.30 | 0.25 | 0.019 | 0.002 |
| D | 74 | 0.21 - 0.28 | 0.24 | 0.017 | 0.002 |
| E | 160 | 0.21 - 0.28 | 0.25 | 0.014 | 0.001 |

difference between the two species can often be rather small.

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TABLE 3. Identification ratio, (WNxLN)/HBB, for live, known-age captives from Manitoba, Saskatchewan, and the Northwest Territories (1974, 1977, 1983). Ages as in Table 1.

| Species / Origin / Parameter / Age | Sample | Range | Mean | S.D. | S.E. |
|---|---|---|---|---|---|
| *A. m. nearctica* | | | | | |
| Great Slave Lake, Northwest Territories | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 34 | 0.32 - 0.46 | 0.40 | 0.030 | 0.005 |
| B | 22 | 0.33 - 0.42 | 0.37 | 0.027 | 0.006 |
| C | 19 | 0.34 - 0.44 | 0.38 | 0.027 | 0.006 |
| D | 12 | 0.33 - 0.43 | 0.38 | 0.032 | 0.009 |
| E | 25 | 0.34 - 0.47 | 0.40 | 0.038 | 0.007 |
| *A. affinis* | | | | | |
| Minnedosa and E. Meadows, Manitoba; Moose Jaw, Saskatchewan | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 73 | 0.20 - 0.37 | 0.30 | 0.039 | 0.005 |
| B | 87 | 0.20 - 0.32 | 0.27 | 0.027 | 0.003 |
| C | 52 | 0.22 - 0.34 | 0.27 | 0.028 | 0.004 |
| D | 55 | 0.22 - 0.32 | 0.27 | 0.018 | 0.002 |
| E | 36 | 0.24 - 0.32 | 0.28 | 0.019 | 0.003 |

TABLE 4. Identification ratio, (WNxLN)/HBB, for live, known-age captives, separate sexes, from all locations, all years. Ages as in Table 1.

| Species<br>Origin<br>Parameter<br>Age | Sample | Range | Mean | S.D. | S.E. |
|---|---|---|---|---|---|
| *A. m. nearctica,* males | | | | | |
| Churchill, Manitoba | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 42 | 0.30 - 0.45 | 0.36 | 0.035 | 0.005 |
| B | 36 | 0.29 - 0.41 | 0.33 | 0.031 | 0.005 |
| C | 35 | 0.28 - 0.41 | 0.32 | 0.034 | 0.006 |
| D | 32 | 0.27 - 0.42 | 0.32 | 0.031 | 0.005 |
| E | 65 | 0.28 - 0.45 | 0.33 | 0.042 | 0.005 |
| females | | | | | |
| A | 32 | 0.30 - 0.46 | 0.37 | 0.040 | 0.007 |
| B | 26 | 0.30 - 0.42 | 0.34 | 0.032 | 0.006 |
| C | 24 | 0.28 - 0.44 | 0.33 | 0.045 | 0.009 |
| D | 19 | 0.28 - 0.43 | 0.33 | 0.047 | 0.011 |
| E | 39 | 0.29 - 0.47 | 0.34 | 0.048 | 0.008 |
| *A. affinis*, males | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 88 | 0.18 - 0.37 | 0.29 | 0.045 | 0.005 |
| B | 84 | 0.22 - 0.32 | 0.27 | 0.021 | 0.002 |
| C | 73 | 0.21 - 0.33 | 0.26 | 0.024 | 0.003 |
| D | 65 | 0.21 - 0.30 | 0.25 | 0.021 | 0.002 |
| E | 169 | 0.21 - 0.31 | 0.25 | 0.022 | 0.002 |
| females | | | | | |
| A | 77 | 0.18 - 0.38 | 0.28 | 0.035 | 0.005 |
| B | 75 | 0.20 - 0.32 | 0.26 | 0.026 | 0.003 |
| C | 60 | 0.21 - 0.34 | 0.26 | 0.030 | 0.004 |
| D | 64 | 0.21 - 0.32 | 0.26 | 0.024 | 0.003 |
| E | 104 | 0.21 - 0.39 | 0.26 | 0.026 | 0.002 |

or for allowing me to examine specimens: American Museum of Natural History, New York; Carnegie Museum, Pittsburgh; Delta Study Collection, Portage la Prairie; Manitoba Museum of Man and Nature, Winnipeg; Canadian Museum of Nature, Ottawa; Royal Ontario Museum, Toronto; U.S. National Museum, Washington, D.C.; zoological museums of the universities of Alaska at College;

TABLE 5. Identification ratio, (WNxLN)/HBB, for museum specimens from Alberta, British Columbia, Manitoba, Northwest Territories, Ontario, Québec, Saskatchewan, Alaska, and North Dakota. Ages as in Table 1.

| Species<br>Origin<br>Parameter<br>Age | Sample | Range | Mean | S.D. | S.E. |
|---|---|---|---|---|---|
| *A. m. nearctica* | | | | | |
| British Columbia, Manitoba, Northwest Territories, Ontario, Québec, Alaska | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 15 | 0.31 - 0.47 | 0.39 | 0.040 | 0.010 |
| B | 12 | 0.26 - 0.38 | 0.34 | 0.032 | 0.009 |
| C | 7 | 0.27 - 0.36 | 0.32 | 0.030 | 0.011 |
| D | 6 | 0.26 - 0.37 | 0.32 | 0.037 | 0.015 |
| E | No data | | | | |
| *A. affinis* | | | | | |
| Alberta, British Columbia, Manitoba, Northwest Territories, Saskatchewan, Alaska, North Dakota | | | | | |
| (WNxLN) /HBB | | | | | |
| A | 34 | 0.21 - 0.38 | 0.32 | 0.039 | 0.007 |
| B | 15 | 0.15 - 0.33 | 0.25 | 0.043 | 0.011 |
| C | 12 | 0.17 - 0.37 | 0.25 | 0.061 | 0.018 |
| D | 2 | 0.19 - 0.29 | 0.24 | 0.071 | 0.050 |
| E | 7 | 0.20 - 0.32 | 0.27 | 0.037 | 0.014 |

Michigan at Ann Arbor; and Wisconsin at Green Bay.

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# Seed Age-Germination Relationships in Plains Rough Fescue, *Festuca altaica* subspecies *hallii*

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Romo, J. T. 1996. Seed age-germination relationships in Plains Rough Fescue, *Festuca altaica* subspecies *hallii*. Canadian Field-Naturalist 110(2): 294–297.

To test the relationship of germination with storage time seeds of seven collections of Plains Rough Fescue (*Festuca altaica* Trin. subsp. *hallii* [Vasey] Harms) ranging in age from 3 to 91 months were germinated at 10 and 20°C in 0.0 or -0.69 MPa of water stress for 400 degree-days. With the exception of one collection, total germination of all collections declined linearly as seeds aged. When seeds were 80 to 91 months of age germination was nearly nil. One collection apparently had an after-ripening requirement as germination increased initially as seeds aged, then declined. Degree-days to 50% of final germination increased linearly as seeds aged; across the seven collections about 1.2 to 1.9 more degree-days were required to reach 50% of final germination for each month of storage. Until optimal storage conditions are identified, Plains Rough Fescue seeds should be sown the first or second spring after harvest to take advantage of maximum seed vigor.

Key Words: Plains Rough Fescue, *Festuca altaica* Trin. subsp. *hallii* (Vasey) Harms, restoration, seed vigor, water stress, fescue prairie.

World Wildlife Fund and the Prairie Conservation Action Plan identified the grassland dominated by Plains Rough Fescue (*Festuca altaica* Trin. subsp. *hallii* [Vasey] Harms) as one of the most threatened ecosystems on the Canadian Prairies (Anonymous 1986). Less than 5% of the prairie dominated by Plains Rough Fescue remains, primarily as small remnants (Grilz and Romo 1995). Even though high priority has been placed on protecting Fescue Prairie, effective conservation strategies will likely also involve restoration. Restoration may range from reintroduction of processes such as fire and grazing to controlling exotic species (Grilz and Romo 1995) and revegetating sites that previously supported this ecosystem.

One of the key issues of restoration by seeding is the need to develop an understanding of seed and seedbed ecology of Plains Rough Fescue. This long-lived perennial grass seldom produces seed (Johnston and MacDonald 1967; Toynbee 1987), thus annual harvest of seeds may not be possible and seeds will have to be stored for future use. Restoration specialists will likely have to rely on collecting large amounts of seed when they are produced and storing them for use at later dates. Germination of Plains Rough Fescue is severely restricted by water stress, but seeds germinate over a broad range of temperatures (Romo et al. 1991; Grilz et al. 1994). The changes in vigor of Plains Rough Fescue seeds with aging are, however, unknown.

The prairie in Canada dominated by Plains Rough Fescue (*Festuca altaica* Trin. subsp. *hallii* [Vasey] Harms) is one of the most threatened ecosystems. One of the most important considerations in restoring Fescue Prairie is the fact that this perennial grass infrequently produces seeds. The purpose of this research was to document aging effects under laboratory conditions on the germination of Plains Rough Fescue collected in central Saskatchewan.

## Materials and Methods

Seeds of Plains Rough Fescue were collected in central Saskatchewan at four sites in 1987 and three in 1988. The 1987 collections were from the Strawberry Hills, Allan Hills, Radisson and Kernen Prairie while the 1988 collections were made at Sonningdale, the Eagle Hills and Kernen Prairie. All collections were made within 100 km of Saskatoon; Romo et al. (1991) and Grilz et al. (1994) provided site descriptions where the collections were made. Seeds were collected from several thousand plants at each site when seeds began to shatter from the inflorescences. After collection, the seeds were cleaned, 200 lots of 50 seeds were counted, and placed in paper envelopes in darkness in the laboratory. Temperatures in the laboratory ranged from 20-22°C and relative humidity ranges from 10-30%. Seeds collected in 1987 were germinated 11, 21, 30, 42, 54, 68, 76 and 91 months after collection while the 1988 collections were tested at 3, 10, 19, 31, 43, 57, 65, and 80 months after harvest. A solution of polyethylene glycol (PEG) (molecular weight 20 000) was prepared to depress osmotic potentials to -0.70 MPa; the osmotic potential of this solution, determined with a Wescor vapor pressure osmometer, averaged -0.69 MPa (SE ± 0.01). This osmotic potential was chosen because it appears to be near a threshold in germination of Plains Rough Fescue (Romo et al.

1991; Grilz et al. 1994). Distilled water was used as a control (0.0 MPa). Seeds were incubated in closed petri dishes on filter paper disks that were moistened by adding 7 mL of water or PEG solution. These petri dishes were enclosed and sealed in clear polyethylene bags to prevent desiccation and incubated in darkness at 10 or 20°C for 400 degree days (base temperature = 0°C). These temperatures were chosen because they are near optimal for germination of Plains Rough Fescue (Romo et al. 1991). Germinated seeds were counted and removed at 2-day intervals. A seed was considered germinated when the plumule and radicle were both 5 mm long.

A randomized complete block design with 50 seeds in each of 4 replicates was used with temperature and osmotic potentials factorially applied within collections and test dates. Within collections and test age, data of total germination and degree-days to 50% of final germination were analyzed with a factorial analysis of variance and the mean across both temperatures and levels of water stress was calculated (Petersen 1985). The mean germination and degree-days to 50% of final germination at both temperature and levels of water stress was chosen as the index of vigor because it represents potential germination over a range of conditions to which seeds would be exposed to in the field. Standard errors for the means were determined and confidence limits were calculated. Regression analyses were used to describe relationships between seed age and total germination and degree-days to 50% of final germination with the best fit regression equation being selected (Snedecor and Cochran 1980). All statistical analyses were conducted at $P \leq 0.05$.

## Results

Total germination of seven of the eight collections declined linearly as seed aged (Figures 1 and 2). The Allan Hills collection apparently had an after-ripening requirement for germination increased initially and then declined (Figure 1). Goodwin et al. (1995) also reported that germination of Idaho fescue (*Festuca idahoensis* Elmer) seeds increased during the first six months after collection and declined thereafter. The after-ripening requirement in the Allan Hills collection of Plains Rough Fescue may be attributed to seeds being collected before full seed maturity, or to a genetically fixed trait or both. The procedures used in the current study do not, however, allow isolation of causal factors.

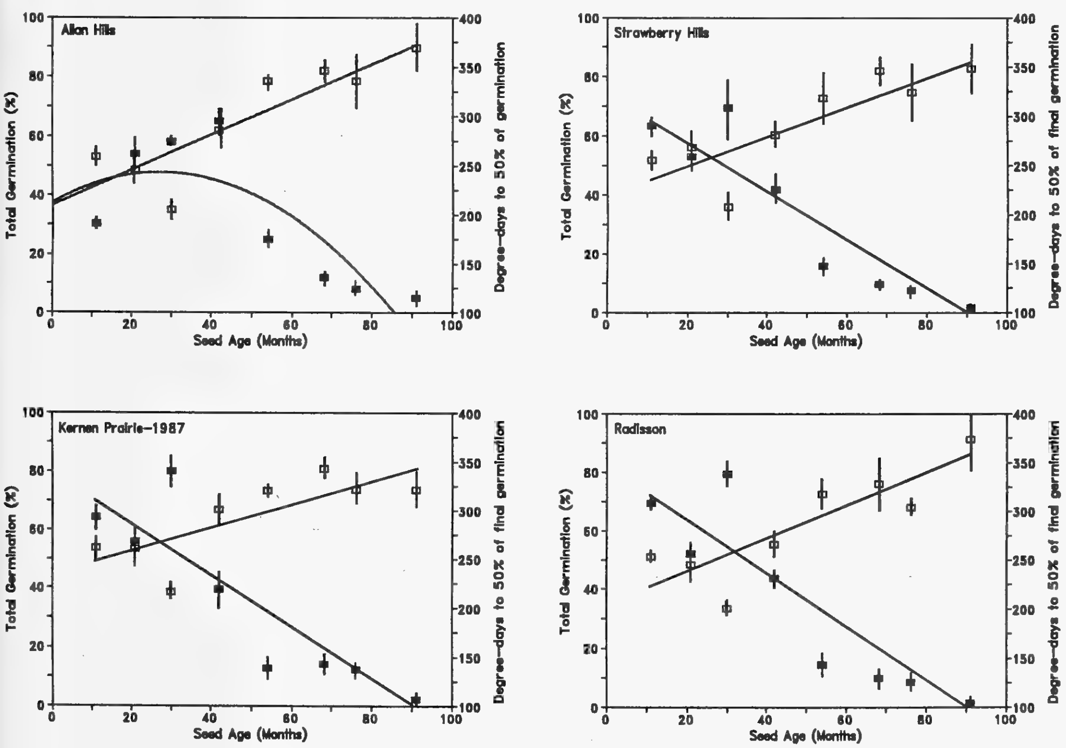


FIGURE 1. Regression lines for total germination (%) and degree-days to 50% of final germination (base temperature is 0°C) for the Allan Hills, Kernen Prairie, Strawberry Hills and Radisson collections of Plains Rough Fescue seeds collected in central Saskatchewan in 1987. Each symbol (solid squares for total germination and open squares for degree-days to 50% of final germination) is the mean of 16 replicates and vertical bars are 95% confidence limits.

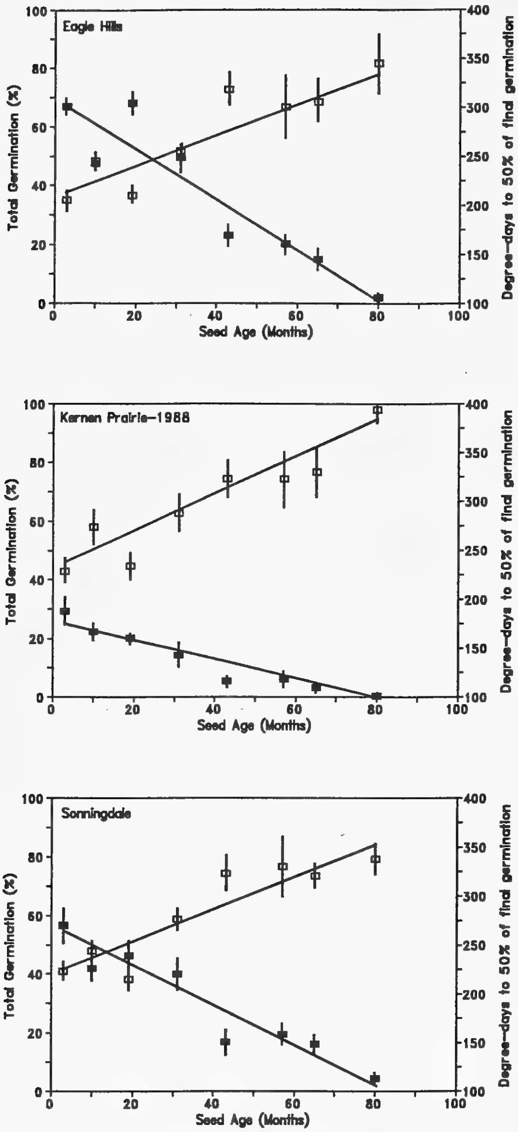


FIGURE 2. Regression lines for total germination (%) and degree-days to 50% of final germination (base temperature is 0°C) for the Eagle Hills, Kernen Prairie and Sonningdale collections of Plains Rough Fescue seeds collected in central Saskatchewan in 1988. Each symbol (solid squares for total germination and open squares for degree-days to 50% of final germination) is the mean of 16 replicates and vertical bars are 95% confidence limits.

Germination was essentially nil at 91 and 80 months for the 1987 and 1988 collections, respectively. Sixty-seven to 94% of the variability associated with total germination was accounted for by seed age (Table 1).

Degree-days to 50% of final germination in all collections increased linearly as seeds aged with 61 to 87% of the variation accounted for by seed age (Figures 1-7, Table 1). For each month that seeds were stored, about 1.2 to 1.9 degree-days were required to reach 50% of final germination. When first tested, the 1987 collections required 221-247 degree-days to reach 50% of final germination while the 1988 collections required 212-224 degree-days. By contrast, on the last germination test seeds required 342-372 and 345-377 degree-days to reach 50% of final germination in the 1987 and 1988 collections, respectively.

TABLE 1. Regression equations describing correlation of seed age with total germination and degree-days to 50% of final germination for seven collections of Plains Rough Fescue.

| Year and Collection | Regression Equation | $R^2$ |
|---|---|---|
| | Total Germination (%) | |
| **1987** | | |
| Allan Hills | $Y^a=37.5+0.76X^b-0.014\bar{X}^2$ | 0.67 |
| Kernen Prairie | Y=80.4-0.92X | 0.80 |
| Strawberry Hills | Y=72.8-0.84X | 0.82 |
| Radisson | Y=82.7-0.97X | 0.83 |
| **1988** | | |
| Eagle Hills | Y=69.1-0.85X | 0.88 |
| Kernen Prairie | Y=26.1-0.35X | 0.90 |
| Sonningdale | Y=56.8-0.67X | 0.94 |
| | Degree-days to 50% of final germination | |
| **1987** | | |
| Allan Hills | $Y^c=210+1.78X$ | 0.76 |
| Kernen Prairie | Y=234+1.19X | 0.61 |
| Strawberry Hills | Y=221+1.47X | 0.71 |
| Radisson | Y=203+1.68X | 0.74 |
| **1988** | | |
| Eagle Hills | Y=207+1.72X | 0.84 |
| Kernen Prairie | Y=228+1.86X | 0.87 |
| Sonningdale | Y=219+1.69X | 0.84 |

[a]Y is total germination (%).
[b]X is seed age in months.
[c]Y is degree-days to 50% of final germination (base temperature is 0°C).

## Discussion

Optimal storage conditions for seeds varies among species (Mayer and Poljakoff-Mayber 1978) and the effects of aging varied among seeds collections of Plains Rough Fescue. Results of the present study illustrated that, with the exception of one collection, vigor of Plains Rough Fescue seed during germination declines as seeds aged from three to 91 months under laboratory conditions. This is consistent with the conclusion of Romo et al. (1991) that seeds of Plains Rough Fescue do not have an after-ripening requirement. Kearns and Toole (1939) also reported that seeds of Chewings Fescue (*Festuca rubra* var. *commutata* Gaud.) tended to loose their viability

quickly. Creeping Red Fescue (*Festuca rubra* L.) retained seed viability poorly compared to several species of grass while Tall Fescue cv 'Alta' (*Festuca arundinacea* Schreb.) produced seedlings after 19 years of storage (Hull 1973).

Research is needed to identify the best combination of conditions for retaining viability of Plains Rough Fescue seeds in long-term storage. Until optimal requirements for seed storage of this native perennial are identified, the following general recommendations should be considered. Seed moisture content should be reduced to 5 to 7% and seeds should be stored at temperatures below -18°C (Bass 1973). If seeds can not be stored under low humidity and temperatures, they should be planted the first or second spring after collection to exploit seed vigor and fulfill the requirements for germination (Romo et al. 1991; Grilz et al. 1994) and seedling growth (Smoliak and Johnston 1968).

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# White-tailed Deer, *Odocoileus virginianus*, Summer Dispersion Areas in Ontario

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Broadfoot, Jim D., Dennis R. Voigt, and Tim J. Bellhouse. 1996. White-tailed Deer, *Odocoileus virginianus*, summer dispersion areas in Ontario. Canadian Field-Naturalist 110(2): 298–302.

Between 1983 and 1989, 168 White-tailed Deer (*Odocoileus virginianus*) were radio-tracked as they migrated out of nine deer yards in Ontario. For four of these yards we tested the hypothesis that summer dispersion areas should be 10 X larger than their associated deer yards since winter range deer densities are about 10 X summer range densities. We found that summer dispersion areas were 13 X larger than their winter yards in terms of forested area, and that this expansion factor was not different form the hypothesized value (P > 0.830). Our results suggested that a reasonable approximation of the size of a summer dispersion area could be achieved by multiplying yard area by 10, and correcting the result to account for forest cover. The ability to predict the size of a summer dispersion area from yard area is important for evaluating the effects of changes to winter and summer range habitat, over or under harvest of deer, and changes in natural deer mortality rates. The relative ease of defining winter yard boundaries simplifies the use of this spatial relationship in management.

Key Words: White-tailed Deer, *Odocoileus virginianus*, dispersion, radio-tracking, Ontario.

White-tailed Deer migrate between summer and winter range in areas of severe winter weather (Severinghaus and Cheatum 1956). In spring, most deer leave winter range (deer yards) and travel to summer home ranges dispersed throughout the surrounding landscape (Nelson and Mech 1981). The resulting distribution defines a summer dispersion area for a population of deer wintering within a particular deer yard.

A literature review suggested that there were consistent differences in deer density between winter and summer range in northern regions where deer migrate. Winter range densities of 6 and 61 deer/km$^2$ were reported, but most were 20 to 30 deer/km$^2$ (Table 1). In contrast, summer range densities of between 0.3 and 11 deer/km$^2$ were reported, with half between 0.5 and 4 deer/km$^2$ (Table 1). We calculated the midpoints of the range of reported winter and summer densities as 25 and 2.5 deer/km$^2$, respectively. This indicated that typical winter range densities were 10 X greater than summer range densities. Because of this 10 X difference in density, it follows that deer should spread out in the summer over a dispersion area which is about 10 times larger than the yard they wintered in, in order for the population to achieve typical summer densities.

In this paper we use data collected in Ontario to test the hypothesis that summer dispersion areas are about 10 times larger than their associated deer yard.

## Study Areas and Methods

Deer were captured in nine yards throughout Ontario during January through March 1983 to 1986 using modified Clover traps, dart guns or rocket nets. Deer were radio-collared and were located at least weekly using aircraft or ground triangulation.

Migration distance was measured as the straight line distance between winter capture location of each deer or each doe/fawn group, and the geometric centre of all its summer locations. Differences in migration distance among yards were assessed using ANOVA and Duncan's multiple range test.

Yard sizes were estimated from radio-locations and aerial and ground surveys. Bias in migration direction was tested using Rayleigh's procedure (Batschelet 1981) for yards with ≥ 20 deer radio-collared. Summer dispersion area was estimated only for yards with ≥ 20 radio-tagged deer since the relationship between area of summer dispersion and sample size reached an asymptote at 18 deer. The total area of summer dispersion was measured from a minimum convex polygon and excluded areas of non-deer range (water, cities, towns). We calculated forest area from the percent forested cover in the total area surrounding each yard. We calculated multiplication factors for each yard as: summer dispersion area (for total land area and forest area) ÷ yard area. The Student's-*t* distribution was used to assess the probability that the average of our multiplication factors was different than our assumed value of 10. We calculated the power (1 - ß) of this test, its ability to detect a real difference, following a procedure outlined by Snedecor and Cochran (1980).

TABLE 1. Summer and winter population densities of migratory populations of White-tailed Deer in North America.

| Reference | Range | Density(deer/km$^2$) | Time of Year | Estimation Method | Location |
|---|---|---|---|---|---|
| Cumming (1961) | Winter | 8.5-46.3 | mid winter | Pellet group survey | Ontario |
| Henderson, et al. (1969)[a] | Winter | 21.9-24.5 | mid winter | Pellet group survey | Ontario |
| Munroe (1972)[b] | Winter | 21.4 yard core | mid winter | Pellet group survey | Ontario |
| Mansell (1974) | Winter | 35 | mid winter | Pellet group surveys | Ontario |
| | Summer | 4 | Pre-hunt | Not provided | Ontario |
| King (1976) | Summer | 1.44 - 2.05 | Pre-hunt | Pellet group surveys | Ontario |
| Schmitz (1990) | Winter | 18-20 yard periphery<br>24-26 yard core | mid winter | Pellet group survey | Ontario |
| Fryxell, et al. (1991) | Summer | 1.3-7.0 | Pre-hunt | Cohort analysis | Ontario |
| Nelson and Mech (1981) | Winter | 39-45 Jonvick yard<br>16-23 Kawishiwi R. and Garden L. yards | mid winter | Aerial Survey<br>Aerial survey | Minnesota |
| Nelson and Mech (1986) | Winter | 5.8-16.9 | mid winter | Aerial survey | Minnesota |
| | Summer | 0.3-0.7 | early spring | Aerial survey | |
| Fuller (1990) | Summer | 4-10 | Pre-hunt | Aerial survey | Minnesota |
| Cumberland and Boer (1991) | Summer | 1.1-2.9 | Pre-hunt | sex/age/kill | New Brunswick |
| Banasiak (1977) | Winter | 27.3-61.0 | early winter | Pellet group | Maine |
| | Summer | 7.7-10.6 | Pre-hunt | adjusted pellet group | |

[a]Ontario Department of Lands & Forests, Parry Sound District, Unpublished Report, 1969.
[b]Ontario Department of Lands & Forests, Parry Sound District, Unpublished Report, 1972.

## Results

Between 1983 and 1989, 168 deer from nine Ontario deer yards, were radio-tracked during at least one migration. Deer from the Loring yard migrated an average of 36 km which was farther than for any other yard ($P < 0.0001$, Table 2). Migration distance did not differ among the other yards ($P > 0.05$, Table 2) which together averaged 11 km (SD = 5.2, n = 92).

Only four yards had enough deer radio-collared to assess direction bias and to determine the size and shape of their summer dispersion areas (Figure 1 a, b). Deer from three yards demonstrated bias in the direction they travelled from their yards ($P < 0.005$: Loring 286°; Copelands 100°; Minesing 10°). No direction bias was evident in the migration movements of deer from the Wood yard ($P = 0.186$).

Summer dispersion areas were 23 times larger than their associated deer yard, in terms of total land area (SD = 17.6, n = 4) (Table 2). Correction of total land area for percent forest cover in the area surrounding each yard (Loring 95%, Wood 93%, Copelands 40% and Minesing 40%) resulted in dispersion areas which were, on average, 13 times larger than their yards (SD = 6.7, n = 4) (Table 2). Neither the total area nor forest area multiplication factor was different from our hypothesized estimate of 10 ($P > 0.370$ and $P > 0.830$ respectively). Both

TABLE 2. Characteristics of White-tailed Deer migration from several yards in Ontario 1983-1989.

| | Distance | | | | | Summer Dispersion Area(km$^2$) | |
|---|---|---|---|---|---|---|---|
| Yard | $\bar{x}$ | (SD) | Maximum | n | Yard Area (km$^2$) | Total Area (Multiple[a]) | Forest Area (Multiple) |
| Loring | 36 | (19.3) | 97 | 76 | 525 | 5548 (10.6) | 5270 (10.0) |
| Wood | 11 | (4.3) | 22 | 25 | 30 | 569 (19.0) | 529 (17.6) |
| Copelands | 13 | (4.6) | 25 | 20 | 12 | 586 (48.8) | 234 (19.5) |
| Minesing | 8 | (2.6) | 15 | 20 | 12 | 153(12.8) | 61( 5.1) |
| Borden | 11 | (5.2) | 22 | 8 | 10 | —[b] | — |
| Cookstown | 7 | (1.7) | 9 | 5 | 5 | — | — |
| Saratoga | 13 | (8.1) | 26 | 6 | 10 | — | — |
| Maitland | 10 | (4.2) | 14 | 4 | 6 | — | — |
| Bayfield | 17 | (7.6) | 28 | 4 | 9 | — | — |

[a]Multiple = Summer Dispersion Area ÷ Yard Area.
[b]Summer Dispersion Area not calculated owing to small sample size.

hypothesis tests had low power (1-ß = 0.1074, total area; 1-ß = 0.0301, forest area).

## Discussion

Our data do not lead us to reject our hypothesis that summer dispersion areas are roughly 10 times larger than their associated deer yards. However, it is important to consider that, owing to low sample size and large variance, the ability of out tests to detect differences was low (low power). Swift (1946) reported that the winter range area of White-tailed Deer in northern Wisconsin was 10% of summer range. Moen (1978) suggested that in areas of deep snow, winter range is often 10 to 20% of summer range. Nelson and Mech (1987) is the only other study that reported similar data on a yard-specific basis. They presented data for four Minnesota deer yards, two of which had a sufficient number of radio-tagged migrating deer to compare with our results. The Garden Lake and Isabella deer yards had summer dispersion areas (considered demes by the authors) which were 23 and 30 times larger respectively. In their study, "the summer range distribution for deer from each yard was measured from the polygon formed by connecting the outermost summer ranges of individual deer" (Nelson and Mech 1987). It appears that their data do not necessarily represent a minimum area polygon, nor were they corrected to account for area of non-deer range (lakes, rivers, settlements, etc.) or forest area. Nevertheless, our results do compare reasonably well with total land area data from their study.

The location of deer yards across regional landscapes remains relatively constant over time spans of 10 to 30 years and perhaps longer, provided that deer are not extirpated by some mortality factor like predation (Mech and Karns 1977). However, at a finer landscape scale, yard size may vary greatly from year to year. This yearly variation occurs because deer restrict their movements to smaller areas as snow depth increases (Hepburn 1959) and as deer population size declines (Broadfoot, unpublished data). Since average conditions represent those which deer are exposed to most frequently over time, we think that they best define conditions under which migration traditions develop. Therefore, when defining yard area, it is important to use data collected during winters having average snow depths and deer abundance.

White-tailed deer population density can change quickly (McCullough 1979). These changes could affect the size of summer dispersion areas if spring migration from yards represented a "random walk" and deer established summer home ranges in the first unoccupied and suitable piece of the landscape. Clearly spring migration is not a "random walk", since deer show strong fidelity to their summer home ranges (Nelson and Mech 1981; Tierson et al. 1985) with migration traditions passed from mother to offspring (Hamerstrom and Blake 1939; Nelson and Mech 1981). Because of the strong tradition of deer migrating to specific areas within a summer dispersion area, it seems that summer dispersion area boundaries should be relatively insensitive to short term (5 to 10 years) changes in population abundance.

Since the multiplication factor we derived using forest area was closer to our assumed value than the multiplication factor derived for total land area, forest area may be significant in this relationship. The most accurate depiction of this relationship would probably emerge when the area of summer dispersion is expressed in terms of both the quality and quantity of deer habitat available on summer range. Therefore, it may be more accurate to say that summer dispersion areas are roughly 10 times larger than their associated yards in terms of deer habitat available in the surrounding landscape. For example, a deer yard measuring 20 $km^2$ with surrounding landscape offering 80% forest cover would have a summer dispersion area measuring 250 $km^2$ ($20 \times 10 \div 0.8$).

The ability to predict the size of summer dispersion areas is significant in resource management. It allows managers to anticipate the spatial extent of activities which affect deer while they are wintering in yards (eg., loss of habitat through development, high winter mortality due to severe winter weather, effects of supplemental or emergency deer feeding, etc.). It also allows managers to determine where harvest should be allocated to achieve yard specific deer population goals.

Although it seems we have a simple "rule of thumb" to determine the size of a summer dispersion area, depicting their shape is not a simple matter since deer show significant bias in the direction they migrate from yards (Sparrow and Springer 1970; Verme 1973; Hoskinson and Mech 1976; Nelson and Mech 1981). In some situations deer are prevented from moving in a particular direction by large water bodies, cities, and other barriers. In our study, deer showed migration direction bias in the absence of any apparent barriers to their movement. We speculate that the spatial distribution of adjacent deer yards may influence the shape of summer dispersion areas.

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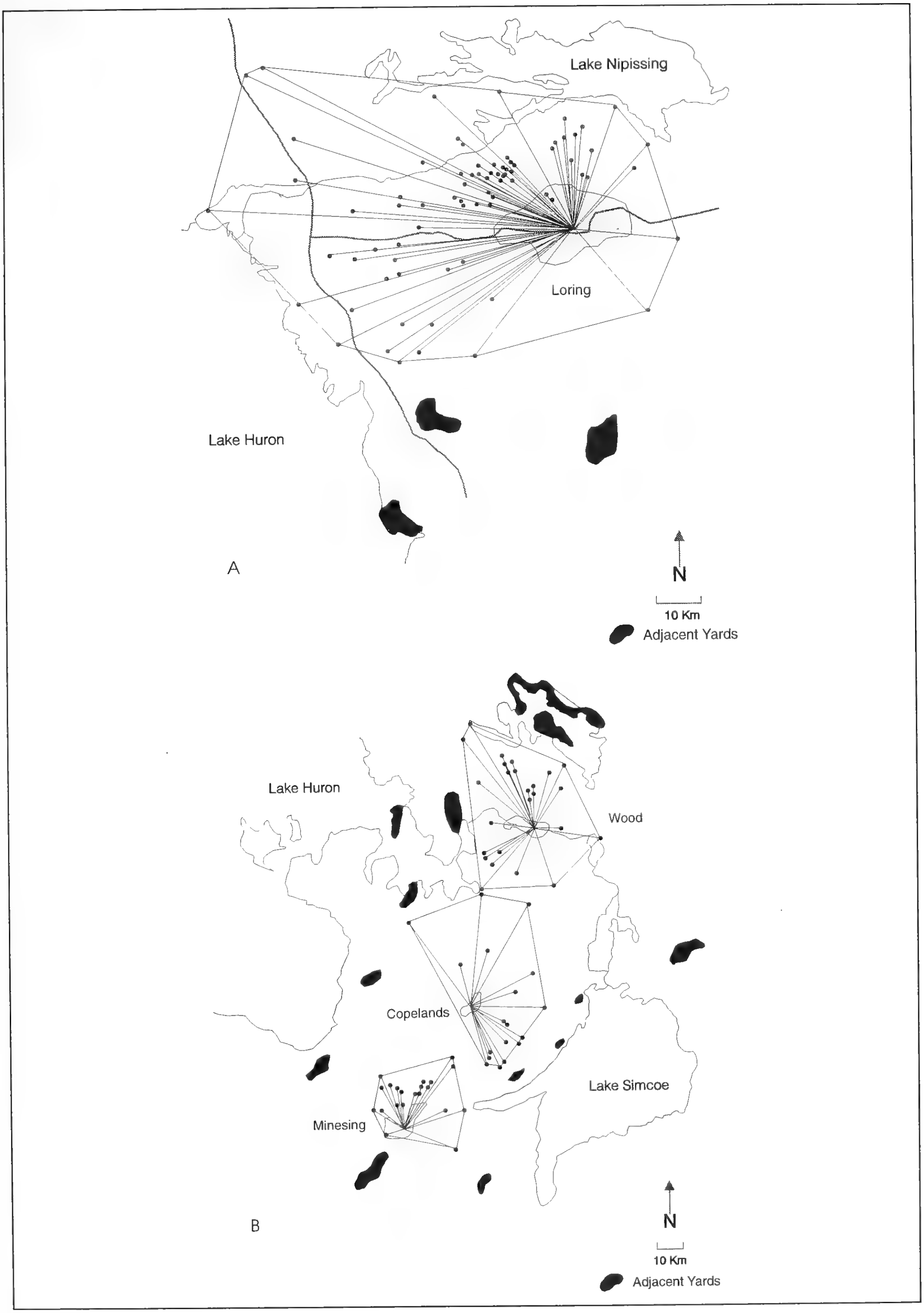


FIGURE 1. Distance and direction of migration movements of White-tailed Deer from Loring (1a), Wood, Copelands, and Minesing (1b) deer yards in Ontario 1983-1989. Each closed circle depicts the summer home range location of an individual deer. The outer boundary defines a minimum convex polygon. Adjacent deer yards shown as solid filled polygons.

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# Berry Consumption by the American Robin, *Turdus migratorius*, and the Subsequent Effect on Seed Germination, Plant Vigour, and Dispersal of the Lowbush Blueberry, *Vaccinium angustifolium*

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The American Robin, *Turdus migratorius*, is a major frugivore of the Lowbush Blueberry, *Vaccinium angustifolium*. Laboratory observations established that young robins were capable of rapidly consuming large numbers of berries. After each experimental feeding, excreta were collected, seeds extracted and sown. Germination of excreted seeds was reduced by approximately 17% compared to control seeds. Corroborative evidence was obtained from subsequent field studies in 1985, 1989, and 1993 where the germination success of *V. angustifolium* seeds from 157 robin excreta collected along the edges of four Nova Scotia blueberry barrens showed a 24% decrease in germination compared to those of control seeds. In 1993 in vitro studies, seeds extracted from fresh fruit were free from pathogens except for a few yeasts; seeds extracted from rotting fruit were largely infected by *Botrytis*, *Aureobasidium* and *Cladosporium* spp., but seeds extracted from robin faeces were invariably infected by bacteria and *Mucor* spp. as well as 17 additional pathogens.

Key Words: American Robin, *Turdus migratorius*, Lowbush Blueberry, *Vaccinium angustifolium*, feeding, seed germination, plant vigour, dispersal, pathogens, Nova Scotia.

Frugivorous birds and berry-bearing plants are often highly interdependent. Therefore, seed dispersal by avian frugivores is regarded as a quasi-mutualistic process from which both birds and plants benefit (Snow 1971; Snow and Snow 1988; Cook 1982; Herrera 1982). Many birds depend on the nourishment of the pulp in fruits, while the necessity among plants is to attract seed dispersers to complete a critical phase of their reproductive cycle (Herrera 1982). The pulp in fruit represents an energetic cost for the plants but an attractive reward to birds (Morton 1973; Stapanian 1980). The seeds are a reproductive necessity to plants but are an energy cost for birds in terms of digestive processing (Snow and Snow 1988; Stapanian 1980). In general, birds select fruit with low seed to pulp ratio (Izhaki 1992).

Consequently, whenever a bird consumes a berry, it performs its role of the interaction by dropping the seeds anywhere away from the parent plant. Whether it goes to another plant of the same species for a later feeding is irrelevant or even disadvantageous for the first visited plant, as seeds and seedlings often suffer disproportionate mortality near parent plants (Howe 1986). Therefore, dispersal facilitates the colonization of a new habitat and aids gene flow (Levin and Kerster 1974). Indeed, dispersal may also lessen the risk of seed predation by moving seeds away from the parent plant where their availability is highly predictable (Herrera and Jordano 1981; Janzen 1969).

One such berry-bearing plant is the Lowbush Blueberry, *Vaccinium angustifolium* Aiton. This species is a North American endemic restricted to acid soils and is most commonly found in open areas where it fruits from June to September (Vander Kloet 1988). According to Stiles (1980) the berries are high in sugars and low in lipids and persist a relatively short time on the plant. More specifically, Usui et al. (1994) found that 100 g of blueberries contain 1.47 ± 0.34 Kcal of fat, 2.12 ± 0.18 Kcal of protein and 43.43 ± 5.73 Kcal of glucose for a total energy estimate of 52.5 Kcal/100 g. Vander Kloet and Austin-Smith (1986) found that the pulp of each berry contains about 250 calories and the ratio of seed energy to pulp energy is about 1:15.

Avian dispersers of blueberries include grouse (Tetraonidae), catbirds and thrashers (Sturninae, Muscicapidae), towhees (Emberizinae, Emberizidae), and thrushes (Turdinae, Muscicapidae) (Martin et al. 1951). Indeed, Wheelwright (1986) found that *Vaccinium* berries were one of the 10 most common fruits in the stomach contents of the American Robin. Furthermore, some avian taxa pass seeds through their digestive tracts in a completely viable state while others kill some or all of them. The latter are classed as seed predators, the former as seed dispersers. However, the effect of passing *Vaccinium* seeds through an avian gut is not known, although Krefting and Roe (1949) found that passing blueberry seeds through mammalian guts reduced germination by at least 20%.

Among the numerous avian consumers of *Vaccinium angustifolium* berries, the American Robin *Turdus migratorius* L. is considered the most important in eastern Canada (Eaton 1957; Vander

Kloet and Austin-Smith 1986). Hence, the purposes of this study were (1) to feed ripe blueberries to robins in order to assess the effect of passage of seed through the gut on seed viability and seedling growth of *V. angustifolium.* (2) To compare the results from the captive trials with observations from wild populations of robins foraging on *V. angustifolium.* (3) To examine and identify pathogens on seeds separated from excreta and from fresh and fallen berries which might retard germination.

## Materials and Methods

(1) *Captive bird trial:*

*Provenance and Maintenance of Birds*

A nest containing four, approximately 2-week-old, American Robins was obtained from the Gaspereau Valley, Kings County, Nova Scotia, on 11 June 1984, under Environment Canada permit Number 0759. The birds were kept in an indoor aviary ($2m^3$) until they had adequately mastered flight, then were retained in a larger outdoor 3 x 3 x 4 m aviary. The robins were held in captivity 34 days and were released upon completion of the experiments. The birds remained healthy throughout the experimental period. During captivity, they were fed a highly proteinaceous diet approximately 15 times per day using blunt forceps and a small spatula (Formulae in Crossland 1986).

*Provenance and Maintenance of Plants*

Fifty 4-year old plants of *V. angustifolium* grown from seed collected at 40 loci in eastern North America from West Virginia to Newfoundland (see Vander Kloet 1978, for details) were transplanted to 14 cm clay pots in 1983 and kept in cold frames until 3 April 1984 when they were brought into the Acadia University Greenhouse in order to force early flowering so that the ripening of fruit would coincide with the fledging of the robins.

Once anthesis occurred, plants were placed *en masse* outside for several sunny and warm days in early May so that the native pollinators had an opportunity to cross-pollinate them. After anthesis, plants were returned to the greenhouse and watered daily, in order to obtain optimum berry development. Berries ripened in about 45 days. Prior to being placed in the aviary, we picked 300 berries for control, i.e., 6 from each plant. Seeds were washed from each berry and air-dried; only the plump seeds were counted from each berry because Bell (1957), Darrow (1941), and Vander Kloet (1978) among others observed that small imperfectly formed seeds are not viable. *Vaccinium angustifolium* has direct germination, i.e., seeds germinate best immediately after dispersal (Hall et al. 1979).

*Feeding Experiments*

Five blueberry plants were put into the aviary so that the robin's feeding habits could be observed. The number of ripe berries on each plant was recorded in order to calculate how many berries were consumed within a given time.

Sixteen feeding experiments were conducted from 19 June to 6 July, 1984. Blueberry feedings were completed each morning between 09:00 and 09:30 ADT. The floor of a separate aviary was covered with paper so that the faeces could easily be recovered. Then one robin, arbitrarily chosen from the four, was fed 5 to 10 berries using blunt forceps and left in the aviary. Several changes in procedure were made as the birds matured and became more wary. Instead of isolating a bird in a second aviary for blueberry feedings, it was left with the others. Faeces containing blueberry remains were easily distinguished by their characteristic blue color. Still later, when the robins were no longer receptive to hand-feeding, a large dip net was used to capture a robin, which was then put in a separate aviary where blueberries had been set out previously. The berries were eaten rapidly once the bird was left undisturbed. A minimum of 2 h was allowed for defecation after each feeding trial before excreta were collected.

*Germination Trials*

All excreta from each feeding trial were collected; then 50 plump seeds were extracted with forceps, and placed on top of a 1:1 mixture of sand and peat in a 9 cm plastic pot. Pots were then placed in a misting chamber under a regimen of 16 h light: 8 h dark and ambient temperature. Corresponding control pots were set up after each feeding experiment. These pots contained 50 seeds of *V. angustifolium* extracted from fresh blueberries as outlined above. In all, 18 control and 18 excreta pots were set out from 19 June to 6 July 1984.

Each pot was observed daily for emergence of the first radicle, first cotyledons and first leaf. On 17 September 1984, the total number of germinants per pot was recorded. The small seedlings were removed from each pot after counting, leaving only the most robust seedling to develop. On 3 October, another seedling count was made to record later germinating seeds; these were also removed.

*Data Analysis*

Total number of germinants per pot was recorded after two months and subjected to a one way ANOVA to determine whether seed ingestion by robins affected the viability of seeds compared to seeds extracted from fresh fruit. Because of unequal variances and non-normal distributions, non-parametric Mann-Whitney U-tests were performed at each stage (day of appearance of first radicle, first cotyledons and first leaf) to determine whether germination times of robin-ingested seeds differed significantly from those of controls.

(2) *Field Studies:*
*Collection and germination*

In order to corroborate our experimental data, 157 robin excreta were collected during the 1985, 1988, and 1993 fruiting seasons along the edges of four Nova Scotia blueberry barrens, viz., at the Canne Barrens, Sherwood, Lunenburg County, at the Powell Barrens, Gore, Hants County, at the Biorachan Barrens, 5 km NE of Earltown, Colchester County, and the Parrsboro barrens just east of the town, Cumberland County.

These excreta were collected in the following manner. Whenever we observed a small flock of robins feeding in a blueberry barren, we followed, using binoculars, the birds to perching and ablution sites where fresh excreta were collected and individually placed in new 18 ml nalgene vials. Under a dissecting microscope, well filled, plump seeds of *V. angustifolium* were removed from each faecal pellet and counted. Lots of 50 seeds were either sown directly on a 1:1 mixture of sand and peat, or the 50 seeds were mixed into a 2 cc faecal-bolus, which was then placed on a 1:1 mix of sand and peat: the latter method simulated field conditions with the faecal pellet intact, the former after the faecal pellet had been reworked by wind and rain.

For control, several hundred blueberries were picked from areas where robins had been foraging. Berries were chopped for 30 sec in a Waring blender, then the pulp was washed away, and the seed dried, after which samples of 50 plump seeds were separated and sown as described above.

Plump seeds of *V. angustifolium* were separated individually from excreta collected during August 1993 from the Parrsboro barrens, in a positive-pressure laminar-flow transfer hood, to 15 ml test-tubes, half of which were filled with about 10 ml half-strength Bacto Potato Dextrose Agar to encourage fungal growth, the other half with blueberry barren soil-agar to simulate field conditions. Similarly, 100 fresh berries and 100 fallen berries were collected from these barrens and individually placed in 18 ml neoprene vials. One plump seed was removed from each berry to a 15 ml test-tube in a positive-pressure laminar-flow transfer hood with scalpel and forceps that were flame sterilized between each transfer. For every treatment 25 to 27 test-tubes were set up and then incubated for 4 months in a growth chamber set at 16 h light at 21°C and 8 hr dark at 15°C.

Test-tubes were checked daily for fungal growth and seed germination; mycelia observed growing into agar were looped out and transferred under sterile conditions into petri dishes with dextrose agar, incubated and allowed to sporulate so that each fungus could be identified if possible. *Agar preparation:* (1) *One-half strength PDA* — Add 19.5 g Bacto Potato Dextrose Agar (Difco laboratories, Detroit, Michigan, USA) to 500 ml of distilled $H_20$, heat to boiling to dissolve completely. Dispense 10-11 ml into each test tube. (2) *50% soil extract agar.* Add 12 g of Bacto-Agar to 500 ml of distilled $H_20$. Heat to dissolve completely, then add soil extract which had been prepared as follows: measure 200 ml blueberry barren soil into a 2000 ml beaker, top up to 1000 ml with distilled water and stir; filter mixture through 8 layers of cheesecloth. Next dilute the filtrate by one-half with distilled $H_20$. Add 500 ml of soil extract to the melted agar. Dispense 10-11 ml into each test tube. (3) *water agar.* Add 12 g Bacto-Agar to 500 ml distilled $H_20$. Heat to dissolve completely. Dispense 10-11 ml into each test tube.

## Results

*Observations of Feeding Habits and Assimilation Rates (1984 experiment)*

Robins readily accepted blueberries at all times. A single robin was capable of consuming 10 or more berries consecutively, swallowing each whole. Plants presented to four young robins, bearing 40 to 50 ripe fruits each, were picked clean by the birds in 2 to 3 minutes.

*Seed Germination and Seedling Development (1984 experiment)*

Ripe berries contained 16 ± 5 plump seeds (n = 300) and, of these, 92% germinated; in contrast 76 %

TABLE 1. Percent germination of *Vaccinium angustifolium*: American Robin excreted seeds vs. seeds from fresh fruit (1984-1993).

| Seed provenance | Seeds from fresh fruit | Seeds extracted from excreta | Seeds in excreta | F | P |
|---|---|---|---|---|---|
| 1984 experimental<br>n = 16; 800 seeds/treatment | 92 | 76 | — | 24.186 | < 0.0001 |
| 1985 Canne & Gore barrens<br>n = 17; 850 seeds/treatment | 54 | 39 | 21 | 11.489 | < 0.0001 |
| 1989 Gore & Biorachan barrens<br>n = 13; 650 seeds/treatment | 58 | 44 | 27 | 7.848 | 0.0001 |
| 1993 Biorachan & Parrsboro barrens<br>n = 10; 500 seeds/treatment | 52 | 41 | 28 | 3.316 | 0.05 |

TABLE 2. Germination of *Vaccinium angustifolium*: robin excreted seeds vs seeds extracted from fresh fruit, 1984 experimental data, 1985-1993 field data.

| | seeds from fresh fruit | | | | seeds extracted from excreta | | | | seeds in excreta | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Characteristics | 1984 | 1985 | 1989 | 1993 | 1984 | 1985 | 1989 | 1993 | 1985 | 1989 | 1993 |
| Number of samples | 16 | 17 | 13 | 10 | 16 | 17 | 13 | 10 | 17 | 13 | 10 |
| 1st radicle emerges (days) | $17 \pm 2^{a}$ | $15 \pm 3^{a}$ | $16 \pm 3^{a}$ | $14 \pm 3^{a}$ | $16 \pm 3^{a}$ | $15 \pm 2^{a}$ | $14 \pm 2^{a}$ | $14 \pm 2^{a}$ | $22 \pm 6^{b}$ | $19 \pm 1^{ab}$ | $18 \pm 4^{a}$ |
| 1st cotyledons emerge (days) | $26 \pm 6^{a}$ | $25 \pm 3^{a}$ | $26 \pm 3^{a}$ | $26 \pm 3^{a}$ | $24 \pm 4^{a}$ | $26 \pm 3^{a}$ | $26 \pm 2^{a}$ | $26 \pm 3^{a}$ | $34 \pm 4^{b}$ | $33 \pm 2^{ab}$ | $28 \pm 3^{a}$ |
| 1st true leaf develops (days) | $42 \pm 10^{a}$ | $52 \pm 16^{b}$ | $51 \pm 11^{b}$ | $49 \pm 9^{b}$ | $38 \pm 6^{a}$ | $40 \pm 4^{a}$ | $45 \pm 4^{a}$ | $48 \pm 8^{b}$ | $69 \pm 10^{c}$ | $72 \pm 7^{c}$ | $46 \pm 4^{ab}$ |

Legend: means ± one standard deviation; means with the same superscript are not significantly different (Mann-Whitney U-test).

of the seeds in faecal pellets germinated (Table 1). This represents a 17% decrease in germination of robin excreted seeds. The observed differences in germination success between faecal and control groups differed significantly (Table 1).

Rates of first radicle emergence did not differ significantly between faecal and control groups (Mann-Whitney $U = 364.5$, $P > 0.10$). Similarly, there were no significant differences ($P > 0.10$) between germination rates of first cotyledons ($U = 361.5$) or first leaves ($U = 360.1$) in either group (Table 2).

*Seed germination of field samples collected in 1985, 1989 and 1993.*

Although open-pollinated berries, collected from blueberry barrens in 1985, 1989 and 1993 contained seeds that had lower germination rates than those obtained from experimental plants of *V. angustifolium* (Table 1), the proportions that germinated in each treatment did not vary substantially from the experimental seed populations, and indeed treatments were significantly different for each of the sampling years (Table 1). In general, a 24% decrease in germination was observed in seeds extracted from robin scats and a 53% decrease in germination when the seeds were sown in a scat bolus compared to germination rates for seeds taken from fresh fruit (Table 1).

That the observed difference in germination rates is due to wilting at the cotyledon stage rather than a failure to germinate is illustrated in Table 2. Whether the seed source is wild or from experimental crosses, the number of days needed for radicle emergence is not significantly different in any treatment or source except perhaps when the seed is sown within a faecal bolus. Only in 1985 were the seeds sown in a faecal bolus tardy in producing radicles. Similarly the emergence of cotyledons is not significantly different for all treatments except again for the 1985 seeds sown in a faecal bolus. Significant divergence occurs only with the emergence of the first leafy shoot.

In all treatments for all years, blueberry seeds began to germinate in about two to three weeks, but losses due to damping off were widespread and pernicious in pots that contained seeds in excreta or extracted from excreta. Should the first germinating seedlings keel over at the cotyledon stage, emergence of the primary leaf will necessarily be delayed until a replacement cohort at the cotyledon stage is established. Hence the delay in primary leaf development in pots that had their seeds set out in a faecal bolus (Table 2) and which eventually accounts for the 17 to 53% decrease in successful germination in the faecal treatment (Table 2).

Seeds of *V. angustifolium* incubated in 1993 on PDA agar, a medium designed to elicit maximum growth of pathogens, had significantly different success in germination: 89% of the seeds extracted from fresh berries germinated successfully; 52% of those

TABLE 3. Number of *Vaccinium angustifolium* seeds germinating on soil agar or on potato dextrose agar (PDA). Seeds were either extracted from fresh fruit, rotting fruit or from robin faeces collected from the Biorachan Barrens and the Parrsboro Barrens during August 1993.

| Seed Source | Fresh Berries | Rotting Berries | Robin Faeces |
|---|---|---|---|
| Number of germinating | | | |
| seeds: on soil agar | 24 | 25 | 39 |
| : on PDA | 24 | 13 | 6 |
| Number of seeds not | | | |
| germinating: on soil agar | 3 | 2 | 13 |
| : on PDA | 3 | 12 | 21 |

Legend: PDA treatment $\chi^2 = 26.301$; $P(\chi^2_{0.001} = 13.815)$.
Soil agar treatment $\chi^2 = 5.327$; $P(\chi^2_{0.05} = 5.991$ NS).

extracted from rotting fruit germinated; but only 22% of those seeds extracted from robin excreta (Table 3). However, parallel samples of seeds incubated on blueberry barren-soil agar showed no such trend ($\chi^2 = 5.327$; $DF_2$ $0.05 = 5.991$). Seeds from both fresh and rotting fruits had similar germination success (89-93%) but seeds extracted from excreta had a success rate of 75% on soil agar, again a decrease of 18% in germination of robin excreted seeds as noted in the previous germination trials (Table 3).

Fifteen pathogens were isolated from the three seed sources cultured on the two media. Similar assemblages were isolated from both media but growth was so slow on the soil agar that the pathogens did not overwhelm the germinating seed, either extracted from fresh fruit or from rotting fruit. Only on ten seeds extracted from scats did we observe a mixture of bacteria and fungal hyphae so thick that it killed the germinating seed on soil agar.

In contrast, seeds extracted from fresh fruit were free from infection in both PDA and soil agar. In 54 vials, only 12 occurrences of yeasts (*Saccharomyces* spp) were isolated (Table 4). Seeds from rotting fruits had at least nine groups of pathogens including bacteria; *Botrytis* spp., *Aureobasidium* spp. and *Cladosporium* spp. were especially common (Table 4). Seeds from excreta had the highest diversity of pathogens with bacteria and *Mucor* spp. the most prevalent (Table 4).

TABLE 4. Number of pathogens isolated from *Vaccinium angustifolium* seeds incubated on soil agar and potato dextrose agar. Seeds were either extracted from fresh fruit, rotting fruit or from robin faeces collected from the Biorachan Barrens and the Parrsboro Barrens during August 1993.

| Seed Source | Fresh Fruit | Rotting Fruit | Robin Faeces |
|---|---|---|---|
| Bacteria | — | 6 | 52 |
| *Saccharomyces* | 12 | 7 | 6 |
| *Botrytis* | — | 35 | 1 |
| *Aureobasidium* | — | 44 | 6 |
| *Cladosporium* | — | 38 | 19 |
| *Mucor* | — | — | 46 |
| *Epicoccum* | — | — | 16 |
| *Fusarium* | — | — | 5 |
| Taxa with one occurrence | — | 4 | 11 |

## Discussion

Germination of *Vaccinium angustifolium* seeds consistently decreased by approximately 17% after they had passed through the robins' gastrointestinal tracts. This corresponded to the findings of Krefting and Roe (1949) who observed a 20% reduction in germination rate of blueberry seeds that had passed through the guts of three rodent species. This reduction in germination rate may in part be due to bacterial and *Mucor* infection. In vitro, bacterial colonies and fungal hyphae were observed growing on all testa which had been extracted from robin faeces collected in the field in contrast to seeds extracted from fresh ripe fruit where only a few yeast infections were found on the testa. Moreover, *V. angustifolium* seeds are small, weighing only 31 ± 5 mg/100 seeds (Crouch and Vander Kloet 1980). Therefore, the plant actually invests little energy in the production of individual seeds. Pritts and Hancock (1984) found that *V. angustifolium* populations allocate on average only 21% of total plant biomass to fruit and seed production most of which is destined for berry pulp, racemes, and pedicels. Vander Kloet and Austin-Smith (1986) estimated that the total calorific value of all seeds in a single berry is only 16 ± 2 calories compared to 246 ± 62 calories for the pulp. Thus if the energetic investment per seed is minimal, it can be argued that the destruction of some seeds by ingestion is not a major loss to the parent plant, just part of the cost of dispersing seed away from parent plants.

Ingestion of blueberry seeds by robins had no effect on vegetative development. We have no evidence that the robins' digestive processes significantly help soften or partly digest the seed coat, thereby accelerating germination (Table 2). Short-passage times may account for the limited effect of ingestion by robins. Generally, the bulk of seeds was defecated within 35 minutes after feeding.

It can be argued that there are several benefits of Lowbush Blueberry consumption by the American Robin. They move seeds away from the parent plant, thus decreasing local seed densities and increasing the chance that some seeds will be deposited in an area suitable for germination. During the dispersal process, testa are scarcely abraded while in the robins' digestive tract (Crossland 1986). In addition, our observations of the robins' feeding habits indicated that they were capable of consuming large quantities of berries in a short time. This is advantageous as the ripened berries should be dispersed before they fall to the ground beneath the parent plant where, according to Janzen (1970), seedling mortality is often much greater than at more distant sites. Indeed, seeds from rotting fruit had a large array of bacteria and fungi on their testa, especially *Botrytis*, *Aureobasidium* and *Cladosporium* species, but their presence scarcely impeded germination except on PDA media, which of course is designed to elicit maximum fungal growth.

Such contamination is to be expected when the seed source is from small-seeded summer fruits such as *V. angustifolium* which, according to Cipollini and Stiles (1992), have few if any fungal defenses against spores settling on and germinating on berry skins, consequently not only does the fruit rot readily but the testa are infected as well but apparently not to the detriment of successful germination.

The behavior of robins may also decrease dispersal efficiency. Wesley et al. (1986) found that higher seedling densities were found at edges of blueberry barrens where birds perched after feeding: 2.5 ± 0.79 seedlings/$m^2$ along edges compared to 1.1 ± 0.48 seedlings/$m^2$ within the barrens.

Findings of Holthuijzen and Sharik (1985) and Hoppes (1987) similarly indicated that large quantities of seeds are dispersed under perch sites close to foraging areas. Stiles and White (1986) also argued that dispersal is quite local as thrushes and catbirds which fed on berries in thickets rarely moved into adjacent open fields and birds of open fields rarely visited the adjacent forest.

The small but persistent adverse effect that robin dispersal has on *V. angustifolium* seed germination is nevertheless rather surprising given the large pulp reward accruing to the birds. Indeed, these results corroborate the analyses of Jordano (1995) who found that seed dispersal syndromes are not entirely interpretable as current adaptations to seed dispersers. Rather the blueberry may be an adaptation to dispersal agents now long extinct.

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# Group Hunting Forays of Wintering Northern Harriers, *Circus cyaneus*: An Adaption of Juveniles?

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Bosakowski, Thomas, and Dwight G. Smith. 1996. Group hunting forays of wintering Northern Harriers, *Circus cyaneus*: an adaption of juveniles? Canadian Field-Naturalist 110(2): 310–313.

The social interactions of a wintering population of Northern Harriers (*Circus cyaneus*) were studied in the Hackensack Meadowlands tidal marshes in New Jersey. Juvenile harriers were numerically dominant in the population and participated in hunting groups significantly more often than adult males or females. Group sizes varied from 2-4 birds (total groups observed = 66 duets, five trios and two quartets). The occasional inclusion of adults in a foraging group was usually the result of juveniles following the adult, presumably for the parasitic benefits of grabbing flushed prey or exploiting high-yield foraging patches. Our observations suggested a non-territorial wintering harrier population documented by observations of 3-6 different individuals frequently hunting the same 12-ha area each day as well as random use of four study quadrats (3-ha) by individuals of all sexes and ages. Territorial defense was observed in only one adult female, which infrequently attempted to defend a territory. Overall, the prevalence of group-foraging behavior is consistent with the general lack of winter territory in this population.

Key Words: Northern Harrier, *Circus cyaneus*, group hunting, foraging, following, winter ecology, Hackensack Meadowlands, New Jersey.

In general, territoriality is lacking or only weakly exhibited in local wintering populations of the Northern Harrier and Hen Harrier (*Circus cyaneus*) which often gather in large communal roosts from which they fan out to forage over a wide area (Watson 1977). Territoriality or intraspecific agonistic behavior were not observed during hunting forays in the course of intensive studies conducted in Michigan (Craighead and Craighead 1956), the Netherlands (Schipper et al. 1975), or Great Britain (Watson 1977). However, another study in the Netherlands (Boedeltje and Zijlstra 1981) reported that eight adult female harriers defended winter territories in a population ranging from 30 to 60 harriers, but that territoriality was absent among male and juvenile harriers. Bildstein and Collopy (1985) also reported frequent and predictable agonistic encounters between harriers (called escorting flights) in Florida and South Carolina wintering populations dominated by adult females.

In this paper, we report a study of the social behavior of hunting harriers in a winter population numerically dominated by juveniles. We also include several indices of spatial distribution to document the extent of aggregative versus territorial hunting in this communal-roosting species.

## Methods

The study was conducted in the Hackensack Meadowlands district of Bergen County, northeastern New Jersey. The major habitat on the study area is a palustrine tidal marsh dominated by Common Reed (*Phragmites communis*). Harriers also frequently foraged over adjacent overgrown landfills covered with tall grasses, weeds, and occasional small saplings.

A total of 159 h of observation of foraging harriers was made during 51 days in the winters of 1986-1987 through 1990-1991. Snowfall was rare and typically melted in a few days. Harrier numbers and behavior were roughly similar each winter. Observations were conducted at 12 different stations in the study area. In one area where most of the observations were made in 1987-1988 (35 hours), we used a stationary pick-up truck as a blind and noted the use of four adjacent quadrats (3-ha each) of habitat which were divided by a road and a creek. In most cases we could discriminate between males, females and juveniles (unsexed). On some occasions, poor lighting, distance, or brevity of observations prevented distinguishing females and unsexed juveniles, and these were recorded as "brown birds" (after Watson 1977; Bildstein and Collopy 1985). A few birds had distinctive plumage coloration or were missing primaries, which aided in individual recognition. In winter 1988-1989, two harriers were caught in bow-nets baited with live Starlings (*Sturnus vulgaris*). These harriers were banded, marked with tail streamers, and released at the site of capture.

Observations were recorded according to the following criteria: (1) group hunting – 2 or more birds hunting within clear view of each other (< 80 m) with no apparent territorial boundary between them or agonistic behavior. (2) escorting flight – aggressor

chasing bird out of a territory or birds flying in tandem with an aggressive gesture during, before, or after the flight. (3) intraspecific attacks – aggressor attacking a bird with non-aggressive or neutral attitude. (4) piracy - stealing or attempting to steal prey from another bird; (5) interspecific aggression – attacking other species of raptor. Each category was only assigned once per observation, but up to all five categories could be used to describe a single group. To avoid pseudoreplication of observations, we watched each foraging group until it left the area or disbanded.

## Results

Group-hunting forays (n = 78) accounted for 80.2% of social interactions among harriers. Group sizes varied from 2–4, with twos most commonly seen (66 times), followed by trios (5 times) and quartets (2 times). Overall, the duration of group encounters was generally brief; usually less than 3 min., but occasionally up to a maximum of 45 min. In most cases it was not possible to observe exactly when a specific bout started and ended, thus statistics on duration were not accurately determined. The extent of involvement in group-and solitary-hunting forays differed among adult males, females, and juveniles (Table 1). Adult males and females occurred less frequently in groups than did juveniles (Fisher Exact Test, $p = 0.006$ and $p = 0.067$, respectively).

Competitive interactions were characterized by interspecific aggression with other raptors (n = 16), intraspecific attacks (n = 14), escorting flights (n = 4), and piracy (n = 2). Intraspecific aggression occurred at the same rate as group hunting in adults, but only rarely between juveniles or between juveniles and brown birds (Table 2). Juvenile harriers were involved in most group hunting, followed by brown birds, and most of these brown birds were probably juveniles (using the ratio of identified juveniles to females, 69% in Table 1). Usually the non-aggressive group interactions of adults involved tolerating the presence of a following juvenile (parasitic relationship), although possible altruistic (parental/familial) ties could not be excluded as family histories were not known.

The use of space by foraging harriers in a four-quadrat area was studied in winter 1987-1988. Harrier use of space did not deviate from a random distribution, even when stratified by sex and age (Table 3), thus supporting the general trend of non-territoriality observed in all years. On several occasions, as many as three harriers were seen hunting simultaneously within a single quadrat. On days with observations lasting 3 hours or more (n = 7), we were able to identify individually from 3 to 6 different harriers (mean = 4.4) hunting within the same 12-ha grid-zone that day which further demonstrates the non-territorial, overlapping nature of harrier foraging in this tidal marsh. In winter, 1986-1987, an adult female attempted to defend an area; four escorting flights and one interspecific attack were observed, but despite her efforts there were frequent intrusions by many other harriers (Table 3). In late winter 1987, two marked juveniles and a single male that had been captured and released were observed in the same area in close proximity in two of three subsequent sightings.

TABLE 2. Social interactions stratified by sex and age in wintering Northern Harriers in northeastern New Jersey.

| | Group Hunting | | | |
|---|---|---|---|---|
| | Male | Female | Juvenile | Brown |
| Male | 1 | 1 | 2 | 0 |
| Female | — | 0 | 11 | 5 |
| Juvenile | — | — | 27 | 11 |
| Brown | — | — | — | 21 |
| | **Intraspecific Aggression** | | | |
| | Male | Female | Juvenile | Brown |
| Male | 2 | 0 | 2 | 0 |
| Female | — | 2 | 7 | 2 |
| Juvenile | — | — | 2 | 1 |
| Brown | — | — | — | 1 |

## Discussion

Wintering juvenile harriers frequently participated in group-hunting flights in which the relationships could be considered either mutualistic or parasitic. The social relationships between members of a foraging group were cooperative to the extent that very little agonistic behavior resulted despite relatively close individual distances. Adult participation in these social foraging groups was the result of tolerating close following by juveniles. Although social

TABLE 1. Extent of group and solitary hunting forays in wintering Northern Harriers in northeastern New Jersey.

| | Male | Female | Juvenile | Brown | Total |
|---|---|---|---|---|---|
| solitary | 20 | 37 | 62 | 45 | 164 |
| group | 4 | 17 | 51 | 37 | 109 |
| total | 24 | 54 | 113 | 80 | 273 |
| % grouped* | 16.6 | 31.5 | 45.1 | 46.2 | 40.0 |

*the distribution of grouped and solitary harriers differed significantly by sex/age classsification ($\chi^2$, df=3, $p < 0.02$).

TABLE 3. Use of space by hunting Northern Harriers in winter with regard to sex and age in a four-quadrat grid zone in northeastern New Jersey.

| | Area | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | Totals |
| juvenile | 14 | 10 | 27 | 23 | 74 |
| female | 20 | 11 | 12 | 13 | 56 |
| male | 6 | 7 | 5 | 4 | 22 |
| brown | 10 | 3 | 8 | 5 | 26 |
| totals | 50 | 31 | 52 | 45 | * |

*the rows and columns of the 4x4 contingency table were not significantly different ($\chi^2 = 13.052$, d.f. = 9, p = 0.16).

foraging groups are common in birds, mammals, and fish (Morse 1980), such behavior is rather infrequently described for Falconids (Newton 1979; Bednarz 1988; Ellis et al. 1993) which are generally viewed strictly as solitary hunters after family groups disperse in late summer.

In this study, group-foraging behavior was largely restricted to juvenile harriers or to juveniles following adult females. This behavior occurred in a wintering population dominated by juveniles and where winter territoriality among harriers was rare. These conditions were contrary to a study in South Carolina and Florida (Bildstein and Collopy 1985) that reported frequent agonistic encounters as the result of adults (primarily females) trying to defend their territories and to prevent piracy by less numerous invading juveniles. Boedeltje and Zijlstra (1981) reported that winter territoriality occurred only in adult females but other investigators found no evidence of territoriality within wintering groups of harriers (Craighead and Craighead 1956; Schipper et al. 1975; Watson 1977). All studies considered, winter territoriality appears to be relatively uncommon and restricted almost entirely to adult female harriers, thus providing no conflicting field evidence against a group-foraging hypothesis for juveniles.

Watson (1977: 92) stated that it is not uncommon for two or three hunting harriers to be in view at the same time in autumn or winter in Great Britain, when voles are abundant. Dickson (cited in Watson 1977: 92) observed up to five harriers together hunting in two adjacent 34-ha kale fields. While no previous investigators have made specific reference to cooperative-hunting effects between harriers, Watson (1977: 93) reported two interspecific observations of a Merlin (*Falco columbarius*) and a harrier hunting closely together. In these observations, both raptors apparently benefitted from the association by catching birds that were fleeing from the other associate. This association is analogous to a well-known group-foraging technique known as "beating" (Morse 1980; Ellis et al. 1993). Dinsmore (1973) has shown that Cattle Egrets (*Bubulcus ibis*) can increase their foraging efficiency more than three-fold when attending cattle than when foraging alone. Even in the absence of cattle, Wiese and Crawford (1974) have observed cooperative beating by several Cattle Egrets advancing abreast through the vegetation. The latter observation does not differ functionally from our observations of aerial hunting forays by groups of harriers.

Although the mutual and parasitic advantages of beating may be important for hunting juvenile harriers, we were unable to prove its success in the field because prey captures were rarely observed in the tall reed stands (2–3 m). However, on one occasion, two juvenile harriers hunting in parallel formation simultaneously struck at a prey. One hawk was apparently successful as a prey squeal was heard and the harrier remained for 11 min., presumably feeding. With this strategy, inexperienced juveniles can increase their encounter rate with potential prey as well as take advantage of prey that are already startled and which might be less aware of the second following predator. We also postulate that juveniles group more often with other juveniles than with adults because: (1) juveniles might be less adept hunters (Newton 1979) so two or more might expose or flush more prey than each foraging individually, (2) adults are sometimes territorial (Boedeltje and Zijlstra 1981; Bildstein and Collopy 1985) and are, therefore, less likely to tolerate a following parasitic juvenile.

In addition to the effect of beating, group foraging may facilitate location of high-density-prey patches as harriers use foraging by other harriers as cues to locate food (Ekman and Hake 1988). Thus, the habit of winter communal roosting by harriers (see Watson 1977 for a review) may have a central role in facilitating group hunting cooperation. Ward and Zahavi (1973) proposed that communal roosts may serve as information centers on food-source locations. In this regard, Watson (1977) speculated that harriers returning to the roost at dusk with a visibly full crop might reveal the direction of better prey areas [high-yield foraging patches] or that the "hungry" might follow the "full" hawks the next morning. Thus, parasitic relationships may have developed when juveniles followed closely behind an adult, apparently to take advantage of flushed prey or to "steal" the location of high-yield foraging patches.

Bednarz (1988) recently reported on cooperative hunting groups of Harris' Hawks (*Parabuteo unicinctus*) which are mainly sit-and-wait predators. These hawks showed a concerted effort to catch a single large prey item (*Sylvilagus* spp.) which was eaten by the group. In contrast, the harrier is an on-the-wing predator that preys on smaller prey species (voles, songbirds: - Craighead and Craighead 1956; Watson 1977) which are consumed individually. Hence, it follows that the cooperative group-hunting flights of harriers are less highly structured because prey caught are only of advantage to the successful individual.

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# The Dense-leaved Pussy's-toes, *Antennaria densifolia* (Asteraceae: Inuleae): An Addition to the Vascular Flora of British Columbia

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Chmielewski, Jerry, G. 1996. The Dense-leaved Pussy's-toes, *Antennaria densifolia* (Asteraceae: Inuleae): An addition to the vascular flora of British Columbia. Canadian Field-Naturalist 110(2): 314–317.

The first records of *Antennaria densifolia* from southern British Columbia are cited. The identity of previous citations from Montana are questioned. The British Columbia specimens are all pistillate and as such may represent the polyploid, apomictic form of the species. Basal leaf length, involucre length, and the nature of the tips of the upper cauline leaves may best be used to differentiate between *A. densifolia* and *A. pulvinata*. Future collections may indicate that *A. densifolia* has not only a more southern distribution but that it also occurs in the intervening mountainous area between southern British Columbia and the southern Mackenzie Mountains, the latter initially considered to represent the southern limits of the species.

Key Words: *Antennaria densifolia, Antennaria pulvinata,* Dense-leaved Pussy's-toes, flora, range extension, British Columbia.

Renewed interest in conservation biology over the past two decades has resulted in the widespread recognition that the natural diversity of ecosystems must be maintained. Because rare plants and animals are an important part of this diversity, they and their habitats should be protected (Douglas et al. 1981). Proper identification of these taxa is mandatory if they are to be used to support arguments relative to the protection of an area because of its unique natural diversity.

*Antennaria densifolia* A.E. Porsild (Dense-leaved Pussy's-toes) was described as having minute, densely congested, obovate to oblanceolate, or obtuse basal leaves and as such was recognized as a well-marked species of the Alpinae group (Porsild 1945). Basal leaf morphology could readily be used to distinguish *A. densifolia* from both *A. compacta* Malte and *A. cana* Fernald & Wiegand. Although the arctic *A. densifolia* superficially resembles the Cordilleran *A. pulvinata* Greene, the two species differ with respect to the possession by the latter of larger heads, paler bracts, and hispid achenes (Porsild 1945). *Antennaria densifolia* was initially considered endemic to the upper eastern slope of the Mackenzie Mountains in the Northwest Territories. The species is now known to also occur in the Ogilvie Mountains and southern Richardson Mountains of the Northwest Territories and Yukon Territory (Porsild and Cody 1980). *Antennaria densifolia* was said to typically inhabit dry, turfy limestone screes (Porsild 1945).

Porsild (1975) subsequently described a second short-leaved arctic species, *A. ellyae* A.E. Porsild, which could be distinguished from *A. densifolia* by its spreading, leafy, stolon-like branches and by its twice-as-tall flowering peduncle that terminates in an elongated, cymose inflorescence. Chmielewski and Chinnappa (1990) considered *A. ellyae* to be conspecific with *A. densifolia*, noting that the minor differences in vegetative morphology merely reflected a growth response to local environmental conditions.

Using a taxonomic species concept, Bayer (1989a) concluded that *A. aromatica* Evert and *A. densifolia* could be considered discrete species because they are morphologically distinct. The two species were readily distinguished by the presence of stalked glands in *A. aromatica* and the complete lack of these glands in *A. densifolia*. Three additional characters, the presence or absence of flat, scarious, linear-lanceolate tips at the ends of the upper cauline leaves, basal leaf length, and phyllary length, could also be used in concert to separate the species, but not as reliably as the former character. The most significant aspect of this study, however, was that Montana collections were identified as *A. densifolia*, representing a disjunction of approximately 1850 km south of the nearest population in the Northwest Territories.

Chmielewski (1993) used gross morphology of type and non-type material, the Pearson product-moment correlation coefficients presented by Bayer (1988), the protologues of *A. aromatica* and *A. pulvinata*, the fallibility of using glandularity as a diagnostic character, and the results of canonical variates analysis to conclude that *A. aromatica* and *A. pulvinata* are conspecific. The latter specific epithet was deemed the legitimate name for the species.

Bearing in mind that my understanding of *A. pulvinata* has changed over the past decade to include *A. aromatica*, this investigation initially evaluates morphological affinity between *A. pulvinata* and *A. densifolia*. Conclusions based on this evaluation are then

used to reassess the identification of individuals from the single disjunct population of *A. densifolia* reported by Bayer (1989a), as well as assess the identification of several small-leaved British Columbia collections.

**Materials and Methods**

Mature, predehiscent specimens of *Antennaria densifolia* (N=69), *A. pulvinata* (N=153), the disjunct Montana population of *A. densifolia* (both pistillate and staminate specimens of *Bayer, DeLuca and Lebedyk, MT-725,* RM530380, and *Lackschewitz 4611,* MONTU73034) and the small leaved individuals from British Columbia (N=5) were borrowed from ALTA, CAN, CAS, CM, COLO, DAO, F, GH, LEA, MO, MONTU, MOR, MT, NDG, OS, PH, RM, SLRO, UAC, UB, UC, and US (Holmgren et al. 1990) for inclusion in the phenetic study. Qualitative characters used to identify specimens of *A. densifolia* and *A. pulvinata* prior to analysis included habit, degree and type of pubescence, color, shape, and texture of phyllaries, and the presence or absence of papillae on the achenes. These characters were not used directly in the phenetic analysis.

Character selection, and specimen selection and identification followed the methodology of Chmielewski (1993). Data were collected for 16 quantitative characters for each specimen following Chmielewski (1994a) with the exceptions that measurements were made on the middle cauline leaf as opposed to either the lower or upper-one, and that neither style length nor lobe length were included among the characters analyzed. The reasons for selecting these characters have already been stated elsewhere (Chmielewski and Chinnappa 1988a, 1991; Chmielewski et al. 1990a, 1990b; Chmielewski 1993).

The SAS (SAS Institute Inc. 1989) DISCRIM procedure (including the options list, simple, pool, slpool, crossvalidate, crosslist, and posterr) was used to perform classificatory discriminant analysis (following Chmielewski 1994a) on the specimens of *A. densifolia* and *A. pulvinata.* Rates of correct identification and Geisser classification probabilities (Pimentel and Frey 1978; Pimentel 1979) were used as indicators of separation between the species. Tests for equality of group centroids were performed as part of the analysis. The same data set was used to both define and evaluate the classification criterion. Classification through crossvalidation (SAS crossvalidate option) eliminated the problem of circularity in the analysis because each specimen was identified using a discriminant function that was computed from specimens exclusive of the specimen being classified. The classification criterion was subsequently used to classify collections from the disjunct Montana population, as well as the small leaved individuals from British Columbia, to either *A. densifolia* or *A. pulvinata.* A posteriori classification of specimens through the use of the classification criterion assumes that specimens classified in this manner do in fact belong to either *A. densifolia* or *A. pulvinata.*

**Results**

Evaluation of the discriminant function through the use of crossvalidation classification indicated that 98.2% (*Antennaria densifolia,* N=69, 100%; *A. pulvinata,* N=149, 97.4%) of the 222 specimens were assigned (with the highest probability) to the correct a priori species. Geisser assignment probabilities for the 218 correctly assigned specimens averaged (mean ± standard deviation) 0.9809 ± 0.0770 for *A. densifolia* and 0.9811 ± 0.0807 for *A. pulvinata.* The Mahalanobis distance between species centroids and associated F-value indicated that they were significantly different ($P < 0.0001$). The low error count in conjunction with the high Geisser assignment probabilities indicated that a posteriori classification of the Montana and British Columbia collections through the use of the classification criterion would yield acceptable results.

The five small-leaved individuals from British Columbia were consistently classified through the use of the classification criterion to *A. densifolia.* Geisser assignment probabilities averaged 0.9665 ± 0.0523 for these specimens.

Three of the four specimens from the disjunct Montana population of *A. densifolia* were classified using the classification criterion to *A. pulvinata.* Geisser assignment probabilities averaged 0.9638 ± 0.0575 for these specimens. A single staminate specimen (Lackschewitz 4611, MONTU73034) was assigned to *A. densifolia* (0.9970). If however, pistillate and staminate plants were analyzed separately and only those characters identified by stepwise discriminant analysis were subsequently used in the classificatory discriminant analysis, all five small-leaved individuals from British Columbia were assigned to *A. densifolia* (0.9812 ± 0.0331), and all four Montana specimens from the disjunct population of *A. densifolia* were assigned to *A. pulvinata* (0.9255 ± 0.1216).

**Discussion**

Results based on the a posteriori classification of individuals from the disjunct Montana population previously identified as *Antennaria densifolia* do not support Bayer's (1989a) view that they belong to that species, but rather that they bear morphological affinity to *A. pulvinata.* This conclusion is no doubt partly due to the very different interpretation we have relative to morphological variation within *A. pulvinata* and *A. aromatica* (Bayer 1989a, 1989b, 1991; Chmielewski and Chinnappa 1988b; Chmielewski 1993, 1994b) especially with respect to glandularity.

Bayer (1989a) stated that *A. aromatica* occurred only east of the continental divide in predominantly unglaciated areas and hypothesized that it could be restricted to the Front Ranges east of the divide as a result of climatic factors, that is, these mountains receiving less rainfall than those to the west in western Montana and Idaho. Although I agree with Bayer (1991) that two specimens cited by Chmielewski and Chinnappa (1988b) were misidentified at the time, the authors did also report a single British Columbia collection that occurs west of the continental divide in an area which was previously glaciated. Bayer (1991) did not verify the status of the latter collection. The present study also includes several additional collections of *A. pulvinata* from British Columbia as well as one from Idaho. The remoteness of the subalpine habitat in which the species occurs has likely contributed to the paucity of collections.

Although I do not agree with Bayer (1989a) that the previously cited Montana collections represent disjunct *A. densifolia*, five specimens from British Columbia were classified through the use of the classification criterion to *A. densifolia*. These specimens were all pistillate and may represent a polyploid apomictic form of *A. densifolia*. The occurrence of *A. densifolia* in southern British Columbia is not surprising, however, as Bayer (1989a) noted that a more widespread preglacial distribution was likely. As with *A. pulvinata*, the lack of previous reports may simply be a consequence of the remoteness of suitable subalpine to alpine habitat. It is possible that in the future additional collections may be found which will close the distributional gap between these southern British Columbia populations and those in the southern Mackenzie Mountains. Additionally, it is equally likely that more southern populations of *A. densifolia* will be discovered in the future.

*Antennaria densifolia* and *A. pulvinata* may be distinguished according to the following characteristics. Basal leaves in *A. densifolia* are typically less than 6.0 (average 5.4) mm long and the involucre less than 5.5 (average 4.9) mm long. Staminate plants are slightly smaller on average with involucres typically less than 4.5 (average 4.2) mm long. The upper cauline leaves in this species typically terminate in flat, scarious, linear-lanceolate tips. Basal leaves in *A. pulvinata* are typically greater than 6.0 (average 8.7) mm long and the involucres typically greater than 5.5 (average 6.2) mm long. The upper cauline leaves in this species typically lack the flat, scarious, linear-lanceolate tips. Staminate plants are slightly smaller on average with involucres typically greater than 4.5 (average 4.8) mm long. The foliage of *A. pulvinata* may be covered in stalked glands but this is never true of *A. densifolia*.

**British Columbia Specimens:**

Mount Apex, SW of Penticton, occasional in bare, gravelly-rocky areas at summit and on upper slopes, elevation 7000' and up, *J.A. Calder and D.B.O. Savile 10708,* July 18, 1953, DAO443861. Paradise Mine about 15 mi W of Windermere, occasional on bare shale summit, elevation 8500', *J.A. Calder and D.B.O. Savile 11320,* Aug 1, 1953, DAO683766. Baldy Mountain, approximately 7.5 mi ENE of Littlefort, 51°27'N and 120°03'W, occasional in rocky areas near summit, elevation 7228', *J.A. Calder, J.A. Parmelee, and R.L. Taylor 19866,* Aug 1, 1953 DAO683760. Mount McLean at Lillooet, occasional on rocky-gravelly slope, elevation 7500', *J.A. Calder, D.B.O. Savile, and J.M. Ferguson 15576,* Sept 6, 1954, DAO576733. Cathedral Lakes District, Ashnola Range, between Red Mountain and Mount Bomford, 49°04'N and 120°12'W, common in grassy rocky area at 7850', *J.A. Calder, J.A. Parmelee, and R.L. Taylor 19660,* Aug 2, 1956, DAO576739.

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# Dispersal Characteristics of Two-year-old Beavers, *Castor canadensis*, in Western Montana

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The movements of 22 two-year-old Beavers (*Castor canadensis*) were monitored in montane habitat using radio-telemetry. Twelve did not disperse. Dispersal distance, dispersal dates, and settlement dates of 10 dispersers varied. Disperser survival rate was 0.70. Wide variation in dispersal dates, and settlement dates, suggests the existence of a summertime sub-population of transient Beavers, unattached to traditional colonies.

Key Words: Beavers, *Castor canadensis*, Montana, dispersal.

Two-year-old Beavers disperse from natal colonies to establish new colonies, and to replace breeders lost to trapping or natural mortality (Bradt 1938; Svendsen 1980). However, not all two-year-olds disperse from their natal colonies. Observations of colony composition indicate delayed dispersal (Brooks et al. 1980; Peterson and Payne 1986) that might be related to high population density (Bergerud and Miller 1977; Payne 1982; 1984; Busher et al. 1983).

Dispersers generally leave natal colonies in late winter or early spring and live as a "floating" population of transients before settlement (Townsend 1953; Aleksiuk 1968; Svendsen 1980; Allred 1981). They typically move along waterways through occupied territory but are prevented from staying by resident Beavers (Townsend 1953; Aleksiuk 1968; Allred 1981; Hodgdon and Lancia 1983).

Nearly all of what is known about Beaver dispersal comes from mark-recapture studies, a technique limited by recapture success. Mark-recapture studies also provide little information on the timing of dispersal and settlement, or movement during the dispersal-settlement interval. We used radio-telemetry to describe the timing and movement characteristics associated with the dispersal of two-year-old Beavers in western Montana.

## Study Area

Study areas consisted of four secondary drainages of the Clark Fork River in west-central Montana (approximate latitude 47° 00' N, approximate longitude 114° 30' W); Upper Willow and Meadow Creeks in Granite County, Rattlesnake Creek in Missoula County, and Fish Creek in Mineral County. Dominant bank vegetation in all areas consisted of willows (*Salix* spp.), alders (*Alnus* spp.), and Red Osier Dogwood (*Cornus stolonifera*). Surrounding uplands were montane conifer forests (Jackson 1991).

Mean annual precipitation was 40–80 cm/year and mean annual snowfall was 80–160 cm/year. Mean January temperature was -1.1–-17.8°C with 150–210 days/year when temperatures were below freezing (0°C, United States Department of the Interior Geological Survey 1970). In spite of the cold temperatures, these streams were free-flowing and relatively ice-free during the winters of 1989/90 and 1990/91. Springtime high water periods occurred between mid-April and late June (Van Deelen 1991).

## Methods

Beavers were captured in Hancock live-traps (Hancock Trap Co., Custer, South Dakota) baited with fresh Cottonwood (*Populus trichocarpa*), aspen (*Populus* spp.), or willow twigs and a castor-based lure. In 1989 and 1990, trapping began the third week of March and continued through the first week of June.

We immobilized live-trapped Beavers with 150–200 mg of ketamine hydrochloride and 2.5 mg of acepromazine maleate to facilitate morphological measurement and sex determination (Jackson 1991). We assigned age-classes based on morphological development (Patric and Webb 1960; Payne 1979; Jackson 1991). Two-year-old Beavers were intraperitoneally implanted with radio-transmitters (Model IMP400, Telonics Inc., Mesa, Arizona.) using methods described by Jackson (1991). The next day, Beavers were released at the capture site. Radio-transmitters were configured for a minimum battery life of 24 months.

We located transmitter-equipped Beavers weekly in 1989 and every other day in 1990. The increased effort in 1990 was an attempt to refine the move-

ment data. We recorded locations for each Beaver from the time of their release in the spring until construction of a food cache and continued use of the same daytime resting site suggested that the Beaver had selected a site to spend the winter. Dispersal date was defined as the date of the last location in the natal colony. Settlement date was defined as the date of the first location in the subsequent over-wintering site. Beavers alive at the end of the field season were located the following spring to determine over-winter mortality. We located Beavers during daylight hours using signal strength to "home in on" daytime resting sites (White and Garrott 1990), and used fixed-wing aircraft to find Beavers which had moved extensively. Nocturnal or daytime movements that did not require radio-equipped Beavers to establish new resting sites were not considered.

For each record of telemetry locations, we used a plan measure (Alvin and Co., Inc., Windsor, Connecticut) to measure the shortest stream distance from release site to Beaver location (= daytime resting site). We recorded distances to the nearest 0.1 km.

Dispersers were defined as those Beavers that left their capture site (assumed to be within the natal colony's home range) without returning. In all cases, dispersals involved capture site to settlement site distances >2.2 km, the stream distance home range of Beavers in Manitoba (Novakowski 1965). Interpretations of dispersal movements were necessarily subjective. Ours were based on a knowledge of colony locations in the study areas and the assumption that subadult Beavers trapped in a colony were pre-dispersal members of that colony.

A two-tailed Wilcoxon Rank Sum test (Johnson and Bhattacharyya 1987) was used to test for sex-biased dispersal distance, and to test if the distributions of median, maximum upstream, and maximum downstream movements differed between 1989 and 1990. Simple linear regression (Sokal and Rohlf 1995) was used to determine if dispersal dates and dispersal-settlement interval lengths were related to dispersal distances. A G-test (Sokal and Rohlf 1995) was used to test if dispersal proabability was independent of sex. We used the KAPLAN computer program (copyright 1988, Missouri Department of Conservation, Columbia, Missouri) for survival analysis. It is based on Pollock et al.'s (1989) modification of the Kaplan-Meier estimator for the staggered entry of radio-marked animals. Samples from 1989 and 1990 were pooled for survival analysis because of small sample size. Survival was estimated from the Beavers' release in the spring until 6 April of the following year. The survival estimate is roughly equivalent to the life table statistic $p_x$ (Caughley 1977).

## Results

We radio-equipped eight Beavers in 1989 and 14 in 1990. There was no mortality due to the surgical procedures. The Beavers from 1989 were located 279 times and 46 movements > 2.5 km from the release site were detected. We obtained 1299 locations for the Beavers from 1990 and detected 468 movements > 2.5 km from the release site. The mean maximum upstream movement was 3.0 km (SD = 3.5, n = 8, range = 0.2– 5.5 km) in 1989 and 4.7 km (SD = 4.7, n = 14, range = 0.1 - 15.1 km) in 1990. The mean maximum downstream movement was 7.0 km (SD = 13.7, n = 8, range = 0.5 - 40.6 km) in 1989, and 4.7 km (SD = 5.0, n = 14, range = 0.1 - 15.7 km) in 1990. Average median movements were 2.1 km (SD = 2.1, n = 8, range = 0.2 - 5.9 km) in 1989, and 1.2 km (SD = 1.0, n = 14, range = 0.1 - 3.7 km) in 1990. There were no differences in the distributions of median movement distances ($Z$ = - 0.61, $P$ = 0.54), maximum upstream distances ($Z$ = 1.00, $P$ = 0.32), or maximum downstream distances ($Z$ = 0.55, $P$ = 0.58) for Beavers between 1989 and 1990. We saw no evidence of over-land travel.

Three of the Beavers from 1990 were probably captured outside of their natal colonies since they were captured and released at sites that were not near known active colonies. Two of these three had fresh puncture wounds on the hip and tail areas which are indicative of intra-specific fighting (Novak 1987). By contrast, none of the juvenile Beavers caught in active colonies had similar wounds. Movements for the Beavers caught outside of their natal colony were analyzed as if the capture/release site were the natal colony. One of these Beavers settled and was classified as a non-disperser. The other two continued moving and were classified as dispersers.

Four of the dispersing Beavers settled within 16 days. The remaining six dispersers settled between 35 and 181 days. Twelve Beavers (five in 1989, seven in 1990) did not disperse. Three of the non-dispersers and one of the dispersers made exploratory movements to resting sites > 2.5 km from their natal colonies and then returned.

Mean dispersal date (17 May) was highly variable (n = 10, SD = 44 days, range: 7 April - 20 August), as was mean settlement date (24 July, n = 10, SD = 86 days, range: 9 April - 12 November), and the length of the dispersal-settlement interval ($\bar{x}$ = 68 days, n = 10, S.D. = 69, range: 2– 181 days). Dispersal distance was highly variable ($\bar{x}$ = 7.7, n = 10, SD = 5.9 km, range = 2.9– 22.2 km), and not correlated with dispersal date ($r$ = 0.29, $P$ = 0.38), or the length of the dispersal-settlement interval ($r$ = 0.16, $P$ = 0.76).

The sex ratio of the 10 dispersing Beavers was 6 males : 3 females : 1 unknown. The probability of dispersal was independent of sex ($G$ = 0.52, $P$ = 0.47) as was dispersal distance ($Z$ = 0.36, $P$ = 0.64).

Of the eight Beavers from 1989, two (one disperser, and one non-disperser) died during the summer of unknown causes and one (a disperser) died during the winter of unknown causes. One (a non-disperser) was censored (censorships indicate loss of radio sig-

nals despite extensive aerial searches). The sample from 1990 had four mortalities and one censorship. Two (non-dispersers) were removed by a commercial trapper during the trapping season in 1990–1991, one (a non-disperser) was probably killed by a Black Bear (*Ursus americanus*), and one died (a disperser) during the winter of unknown causes. The estimated annual survival rate for the pooled samples of two-year-old Beavers was 0.67 (n = 22, SE = 0.11). For dispersers it was 0.70 (n = 10, SE = 0.14) and for non-dispersers it was 0.64 (n = 12, SE = 0.16).

## Discussion

Dispersal by two-year-old Beavers generally coincides with the birth of the colony's kits, spring runoff, and high water (Svendsen 1980; Hodgdon and Lancia 1983). Dispersal dates were variable in Montana Beavers, and generally coincided with the 10 April - 29 June high water period in 1990 (Van Deelen 1991).

Idaho Beavers in montane habitat dispersed in both upstream and downstream directions (Leege 1968) as did Beavers in this study. Michigan Beavers dispersed over land (Bradt 1938). In the rugged terrain of the western Montana, Beavers are more restricted to travel along the stream courses (Allred 1981), although Leege (1968) reported that one Idaho Beaver crossed the divide between two adjacent drainages.

Dispersal distances in this study varied, but were comparable to the mean airline distance of 5.6 km reported for Idaho Beavers (Leege 1968). At least three non-dispersers and one disperser exhibited large (>2.5 km) exploratory movements away from the natal colony. Nocturnal locations might have enabled us to identify more explorations. These might provide potential dispersers with a method of assessing local colony density by encountering scent mounds (Aleksiuk 1968) and other Beavers (Aleksiuk 1968; Bergerud and Miller 1977; Allred 1981). High density might cause potential dispersers to delay dispersal or return to the natal colony permanently (Molini et al. 1980; Payne 1982).

Twelve of the 22 radio-equipped two-year-olds in this study did not disperse. This is consistent with frequent reports of non-breeding adults in Beaver colonies, and might indicate a high population density relative to the habitat's carrying capacity (Novakowski 1965; Gunson 1970; Payne 1982; Busher et al. 1983; Hodgdon and Lancia 1983). Alternatively, Svendsen (1980) reported 100% dispersal for two-year-old Beavers in a high density population that had no predators and was protected from trapping by being in a state park. We believed that Beaver densities in the study areas were relatively high during the course of the study because fur prices were low and trapping was light.

Late summer settlement and variation in settlement times among dispersers (this study) results in a summer sub-population of transient juvenile Beavers (Townsend 1953; Aleksiuk 1968; Molini et al. 1980) and is probably linked to pair formation. Svendson (1988) found that pair formation among dispersing Ohio Beavers occurred throughout year but peaked during September, October, and November as transients either paired with other transients that recently settled at suitable sites, or were incorporated into existing family groups where the same-sex adult was missing.

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# Microhabitats of Two *Peromyscus* (Deer and White-footed Mice) Species in Old Fields and Prairies of Wisconsin

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*Peromyscus* spp. were live-trapped in old fields and prairie remnants of southern Wisconsin. Microhabitat data were collected at each capture site and at random sites. The Prairie Deer Mouse, *P. maniculatus bairdi,* was the more abundant species, but the Northern White-footed Mouse, *P. leucopus noveboracensis,* also maintained resident, though smaller, populations in these open field habitats. Compared to random trap stations, trap stations capturing *Peromyscus* spp. had more bare substrate, less dead vegetation, taller vegetation, lower forb diversity, and were closer to cultivated fields. Compared to *P. maniculatus*, *P. leucopus* selected microhabitats which had more small-scale three-dimensional structure and which were closer to isolated trees.

Key Words: Prairie Deer Mouse, *Peromyscus maniculatus bairdi*, Northern White-footed Mouse, *Peromyscus leucopus noveboracensis*, microhabitat, old fields, prairies, Wisconsin.

The Prairie Deer Mouse, *Peromyscus maniculatus bairdi,* is characteristic of old field and prairie habitats, whereas the Northern White-footed Mouse *Peromyscus leucopus noveboracensis* is typically a woodland inhabitant (Blair 1940; Harris 1952; Madison 1977). Although densities of *P. leucopus noveboracensis* are highest in wooded habitat, this subspecies regularly occurs in a variety of old field successional stages (Beckwith 1954; Getz 1961; Hirth 1959; Jackson 1961; Lackey 1978; Root and Pearson 1964; Verts 1957). Both of these mice maintain resident populations in old fields and prairies of southern Wisconsin (Kantak 1981; Stromberg 1979a) and have comparable diets (Cogshall 1928; Drickamer 1970; Whitaker 1966). This poses a question as to how these ecologically similar rodents are able to coexist in these habitats. In species that share habitats and diets, differences in microhabitats may be ecologically significant (Kantak 1983). Therefore, the objective of this study was to examine structural and vegetational characteristics of the microhabitats of *P. maniculatus bairdi* and *P. leucopus noveboracensis* in old fields and prairies in southern Wisconsin to determine if differences at this spatial scale could account for the coexistence of these species.

## Study Area and Methods

This study was conducted on 10 sites in south-central Wisconsin. This is the "sand prairie" region of the Wisconsin River Valley, a term which acknowledges both the sandy nature of the substrate and the dry prairie vegetation found there (Curtis 1959). Ten study sites at four geographic localities were chosen to include a range of successional stages from recently disturbed fields to undisturbed prairie. Geographic coordinates of these locales are: Peetz Prairie, Sauk County, 1.5 miles west of Prairie Du Sac at 43°17′16″ N, 89°47′23″ W; Schluckebier Prairie, Sauk County, 1.5 miles west of Prairie Du Sac at 43°17′30″ N, 89°47′30″ W; Spring Green Preserve, Sauk County, 1 mile north of Spring Green at 43°12′06″ N, 90°02′57″ W; Arena area, Iowa County, 0.5 mile north and 0.5 mile west of Arena at 43°10′38″ N, 89°54′46″ W.

Prairie sites were dominated by Big Bluestem (*Andropogon gerardi*), Little Bluestem (*A. scoparius*) and Indian Grass (*Sorghastrum nutans*). The most recently disturbed sites (1 – 3 years) were dominated by Sandbur (*Cenchrus longispinus*), Foxtail (*Setaria glauca*) and Quackgrass (*Agropyron repens*). Older disturbed sites (5 – 15 years) had increasing representation of prairie species and dominant species such as Junegrass (*Koeleria cristata*), Fall Witchgrass (*Leptoloma cognatum*) and Canada Bluegrass (*Poa compressa*).

On each site, 50 Sherman live-traps (5 by 6.4 by 16.5 cm) were set in a 5 × 10 grid pattern with 10-m intervals. In each of the four localities, live-traps were also placed along a 100-m transect with 10-m trap intervals in a windbreak (row of trees) or woodland adjacent to the grassy habitat containing the grids. All traps were baited with mixed bird seed. Grids were trapped at 7-10 day intervals during August-October 1978 and May-October 1979; transects were trapped during June-October 1979. Trap stations were not permanently located and varied somewhat from one trapping session to the next to maintain independence of captures.

*Peromyscus* were identified by using a field discriminant function developed by Stromberg (1979b) for mice collected from the study area. At each trap

station where *Peromyscus* was caught the percent cover of the following variables was measured in $1m^2$ quadrats: bare area, dead vegetation, lichens or moss, *Selaginella* spp., corn stalk remnants, sedges, *Opuntia* sp., shrubs, grasses, and forbs. Cover estimates of individual grass and forb species were used to calculate grass species diversity and forb species diversity (Shannon index, Magurran 1988). Also measured at each trap station were maximum height of vegetation, distance to the nearest tree within 200-m, distance to the nearest windbreak or woods within 200-m, and distance to the nearest cultivated field within 200-m. These microhabitat variables were also measured once a month from June-September 1979 at 20 random trap stations at each grid.

Recapture rates of *Peromyscus* were compared with a G-test (Sokal and Rohlf 1981) on the number of individuals and captures of each *Peromyscus* species in the grids. Discriminant analysis (SPSS 1988) was used to distinguish microhabitats among the three groups- *P. maniculatus*, *P. leucopus*, and random trap stations. The direct entry method of variable selection was used because of statistical advantages over stepwise procedures (Habbema and Hermans 1977; James and McCulloch 1990). Rank-transformed discriminant analysis was applied to the data because it permitted use of the *F*- test and other parametric statistical tests when assumptions of normality and homogeneous covariance matrices were not met by the raw data (Conover and Iman 1980, 1981; Potvin and Roff 1993).

TABLE 1. Summary of discriminant function analysis comparing *P. maniculatus bairdi*, *P. leucopus noveboracensis*, and random microhabitats: significance, coefficients, and classification.

| | Discriminant Functions #1 | Discriminant Functions #2 |
|---|---|---|
| Eigenvalue | 0.29826 | 0.04461 |
| % Variance | 86.99 | 13.01 |
| Chi-square Statistic | 303.6 | 43.495 |
| Degrees of Freedom | 32 | 15 |
| Significance | p < 0.0000 | p < 0.0001 |

Discriminant Analysis Results

| Variable | Standardized DF Coefficient #1 | Standardized DF Coefficient #2 |
|---|---|---|
| Bare Area Cover | 0.54940 | 0.65866 |
| Dead Vegetation Cover | -0.43315 | 0.42621 |
| Lichens and Moss Cover | 0.37455 | 0.21999 |
| *Opuntia* sp. Cover | -0.05137 | -0.41628 |
| Shrub Cover | -0.03533 | -0.30405 |
| Forb Diversity | -0.32580 | -0.17023 |
| Vegetation Height | 0.46152 | -0.24062 |
| Tree Distance | -0.27748 | 0.32626 |
| Windbreak Distance | 0.31172 | -0.08488 |
| Cultivated Field Distance | -0.05656 | -0.43759 |

Group Means of Discriminant Functions

| | Function 1 | Function 2 |
|---|---|---|
| *P. maniculatus* | 1.05065 | 0.25204 |
| *P. leucopus* | 1.13431 | -0.88378 |
| random stations | -0.27812 | -0.00306 |

Classification Matrix

| Actual Group | n | Predicted Group Membership (%) P.m.b. | P.l.n. | random |
|---|---|---|---|---|
| *P. maniculatus* | 164 | 56.7 | 22.0 | 21.3 |
| *P. leucopus* | 44 | 29.5 | 59.1 | 11.4 |
| random stations | 799 | 18.9 | 12.0 | 69.1 |

Total cases correctly classified: 66.6%

## Results

A sampling effort of 10 100 trapnights within field and prairie sites yielded 164 captures of *P. maniculatus*, 44 captures of *P. leucopus* and 20 captures of juvenile *Peromyscus* spp. which could not be identified to species and were not included in the analysis. Recapture rates of *P. leucopus* and *P. maniculatus* did not differ ($G = 0.554$, $p > 0.10$). Sampling in the transects in adjacent windbreaks or woody habitats resulted in three captures of *P. maniculatus* and 70 captures of *P. leucopus* in 1260 trapnights of sampling effort.

Two significant functions of microhabitat data were identified by discriminant analysis (Table 1). The first function explained 87% of the variance and separated stations of both species of *Peromyscus* from random stations. Significant variables separating scores for *Peromyscus* stations from random stations included bare area, low ground cover (lichens and moss), vegetation height and distance to windbreaks. Variables contributing heavily to the discriminant scores of random stations included dead vegetation cover and forb diversity. The second discriminant function explained 13% of the variance and separated *P. maniculatus* stations from *P. leucopus* stations. *Peromyscus maniculatus* scores indicated that bare area, low or dead vegetation cover and distance to trees were important contributors, whereas variables contributing most to *P. leucopus* scores included amount of three-dimensional cover such as of shrubs and *Opuntia* sp., vegetation height, and distance to cultivated fields.

## Discussion

Despite large heterogeneity in microhabitat features across the range of successional stages studied, discriminant analysis identified several common features which classified *Peromyscus* capture stations. The two species of *Peromyscus* were not intermingled randomly across these habitats but each selected microhabitats associated with key habitat features involving amount of cover, three-dimensional structure, and distance to trees or cultivated fields. However, the variables incorporated into these discriminant functions might not be those to which *Peromyscus* are actually responding but could simply be correlated to unmeasured parameters.

Therefore, the ecological importance of significant variables must be considered.

The first discriminant function determined that most of the variability in the data set occurred between random stations and stations capturing either species of *Peromyscus*. The standardized discriminant function coefficients show that *Peromyscus* trap stations had taller living vegetation and less dead vegetation than random trap stations, perhaps related to food supply or quality of cover with respect to risk of predation. *Peromyscus* stations also had more bare substrate and low growth like lichens and moss, which might be related to foraging efficiency for seeds on the ground. Lesser forb diversity relative to random stations may reflect selection by *Peromyscus* spp. for microhabitats with more monotypic cover of preferred plant species. The second discriminant function showed that field-caught *P. maniculatus* and *P. leucopus* were not co-existing in the same microhabitats. *Peromyscus leucopus* selected microhabitats with features characteristic of their more typical woodland habitat, that is, with more three-dimensional structure (shrub and *Opuntia* cover). Also suggestive of wooded habitat were the taller vegetation and closer proximity of trees. *Peromyscus maniculatus* appeared to be more of a grassland generalist whose capture sites were best characterized by what they lacked- heavy vegetative cover and trees.

*Peromyscus leucopus* individuals in my study sites were not all transients or migrants between wooded windbreaks and fields because recapture rates were as high as those of the resident Prairie Deer Mouse. Also, no *P. leucopus* individual was caught in the windbreaks once it had already been captured in the fields. However, the converse did occur- three *P. leucopus* individuals captured in the windbreaks early in the summer were later recaptured in the fields. This suggests that emigration from windbreaks to fields may occur. Because of higher capture rates in windbreaks compared to fields, one might hypothesize that population pressure underlies this movement to grassy habitats. In my study sites, *P. leucopus* is a microhabitat specialist, concentrating its activities in the most structurally diverse areas. It may be able to appropriate these microhabitat patches from resident *P. maniculatus* because of its larger body size (Jackson 1961; Stromberg 1979a) and dominant and aggressive behavior (Fitch 1963; Kantak 1983). This is supported by field experiments in which the persistence of *P. maniculatus* populations was negatively correlated with the density of *P. leucopus*, and removal of one species was followed by an increase in the other (Master 1977). Given its generalist diet and competitive advantage over *P. maniculatus*, why *P. leucopus* is not more successful in grassy habitats is unclear. Differential predation was suggested but could not be demonstrated in field experiments by Stromberg (1979a).

Microhabitats should be selected not only to reduce competition and predation but also to provide appropriate shelter and microclimate, nest sites, and food. Hence a single factor explanation is not likely to totally explain the complex phenomenon we call microhabitat selection. Nevertheless, if the question is how sympatric species with similar diets coexist, examination of the microhabitat should be the first step. Differences in microhabitats reflect the collective effects of a number of selective forces, and further research must sort out their relative contributions.

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# Peatlands: A New Habitat for the Upland Sandpiper, *Bartramia longicauda*, in Eastern Canada

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Although there have been reports of Upland Sandpipers breeding in peatlands of northwestern Canada, our study is the first to demonstrate widespread use of peatlands in other parts of the species' range. In the summer of 1995, while conducting a study on the breeding birds of Quebec's peatlands, we recorded a total of 11 pairs of Upland Sandpipers, in five peatlands in a small region on the south shore of the St. Lawrence River. In the previous year, four pairs had been observed in two of the same peatlands. These peatlands were the largest in the region (160 ha to 496 ha), and consisted mainly of open treeless habitat. The mean density of breeding pairs in 1995 was 0.59 per 100 ha. The availability of large open areas, a low predation rate, and infrequent human disturbance indicate that peatlands could constitute a suitable habitat for the species.

Bien que des mentions de nidification de maubèche des champs aient été rapportées dans les tourbières du nord-ouest canadien, la présente étude démontre pour la première fois l'utilisation de cet habitat par l'espèce dans l'est de son aire de distribution. Au cours de l'été 1995, lors d'une étude sur les oiseaux nicheurs des tourbières du Québec, 11 couples de Maubèche des champs, ont été observés dans cinq tourbières localisées dans unè petite région de la rive sud du fleuve Saint-Laurent. L'année précédente, quatre couples avaient été observés dans deux des mêmes tourbières. Ces tourbières, les plus grandes de la région (160 ha à 496 ha), étaient principalement constituées d'habitat ouvert dépourvu d'arbres. La densité moyenne de couples nicheurs était de 0.59 pour 100 ha en 1995. La disponibilité de grandes surfaces ouvertes, un faible taux de prédation, ainsi qu'un niveau de perturbation humaine presque inexistant pourraient faire des tourbières un habitat convenable pour l'espèce.

Key Words: Upland Sandpiper, *Bartramia longicauda*, peatland, grassland, open habitat, Québec.

The Upland Sandpiper (*Bartramia longicauda*) is a species of the American grasslands, scarcely and locally distributed in much of its range (Peterson 1994). It usually inhabits grassland pastures, tallgrass prairies, blueberry barrens, airport runways, and recently burned or mowed areas (Askins 1992). In the Northwest, Upland Sandpipers are occasionally observed in clearings in spruce muskeg (Palmer 1967), on montane grasslands (Gabrielson and Lincoln 1959), and even in peatlands (Godfrey 1986).

Like many North American game species, Upland Sandpipers experienced near-extinction at the turn of the century. This decline was halted around 1920, with the help of the Migratory Bird Convention, (Osborne and Peterson 1984), as no open season has since been declared for this species. In spite of a period of recovery marked by the apparent westerly expansion of the species' range, the number of Upland Sandpipers began to decline again in almost every northeastern and central region. For instance, its numbers in Illinois decreased by approximately 95% between 1956–1958 and 1978–1979 (Anonymous, cited in Askins 1992). In the New England states, the species became uncommon to rare, and it is still a species of special concern in many of these states (Vickery 1992). Moreover, the Upland Sandpiper was on the Blue List from 1975 to 1986 (Tates 1986), and is one of the species classified as threatened on its breeding grounds (Thompson et al. 1992). However, the results from the Breeding Bird Survey (BBS) show a positive trend of the species population in its entire area of distribution between 1966 and 1994 with a mean percent of annual change of 2.0% ($p \leq 0.001$). Most of this increase seems to have taken place before 1980, as the recent BBS trend (1980–1994) indicated a rate of annual change of 0.2% (non significant). In Québec, for the same period, this mean percent of annual change reached -3.0%, though this value was non-significant (Sauer et al. 1995*). A recent summary on shorebirds based on documented data and surveys indicates a possible general decline of the Upland Sandpiper throughout Canada with the current population estimated at 2000 individuals (Morrison et al. 1994). Therefore, while some studies show encouraging signs for the species, the overall status of the Upland Sandpiper warrants further attention.

In this paper we report on recent observations of Upland Sandpipers in peatlands. We discuss these findings in relation to previous knowledge of the species, while emphasizing their importance in regards to Upland Sandpiper's present status.

*See Documents Cited section before Literature Cited.

## Methods

*Study sites*

This study was conducted in 1994 and 1995, between 5 June and 14 July. In 1994, we visited 137 peatlands, roughly distributed along the Saint Lawrence River lowlands, between the Québec/Vermont border and Havre-Saint-Pierre on the North Shore. In 1995, 72 peatlands were sampled south and west of Quebec City (Figure 1). In 1995, we also counted birds in open habitats, i.e., mostly hayfields (41) and pastures (10), abandoned farmlands (7), recent clearcuts (4), grain crops (6), fields of clover (3), food crops (2), cranberry farms (1), and young plantations (1).

*Sampling methods*

In 1994 the fixed-radius point-count was used to measure species diversity. One 10-min observation period was carried out in each of the 137 peatlands, where all birds seen or heard within a radius of 100 m were recorded. When peatlands were large enough, a second point count was conducted at a distance of at least 1 km from the first point count. Plots were located at least 150 m from the peatland's edge. Vegetation was sampled in each circular plot by visually estimating the percentage of the different vegetation types, as well as the percentage of open water. Vegetation types consisted of the following strata: forbs, ericaceous shrubs, trees <2 m, trees between 2 and 5 m, and trees >5 m.

In 1995 the point-count technique was again used. We placed one count in each distinct habitat type in the peatland; thus their number depended on the peatland's heterogeneity. In the surrounding open habitats we used single point-counts. In the peatlands, birds were also sampled along 200-m wide transect strips. We recorded the positions of all birds seen or heard in the strips. All transect lines were situated at least 200 m from the peatland edge and 300 m from each other. The total area sampled in each peatland represented a minimum of 30% and a maximum of 67% of its surface. Each peatland was surveyed once during the breeding season. Like many other shorebirds, Upland Sandpipers are mostly silent during incubation. However, we considered that failure to detect breeding Upland Sandpipers was unlikely since our surveys started around the first week of June. By

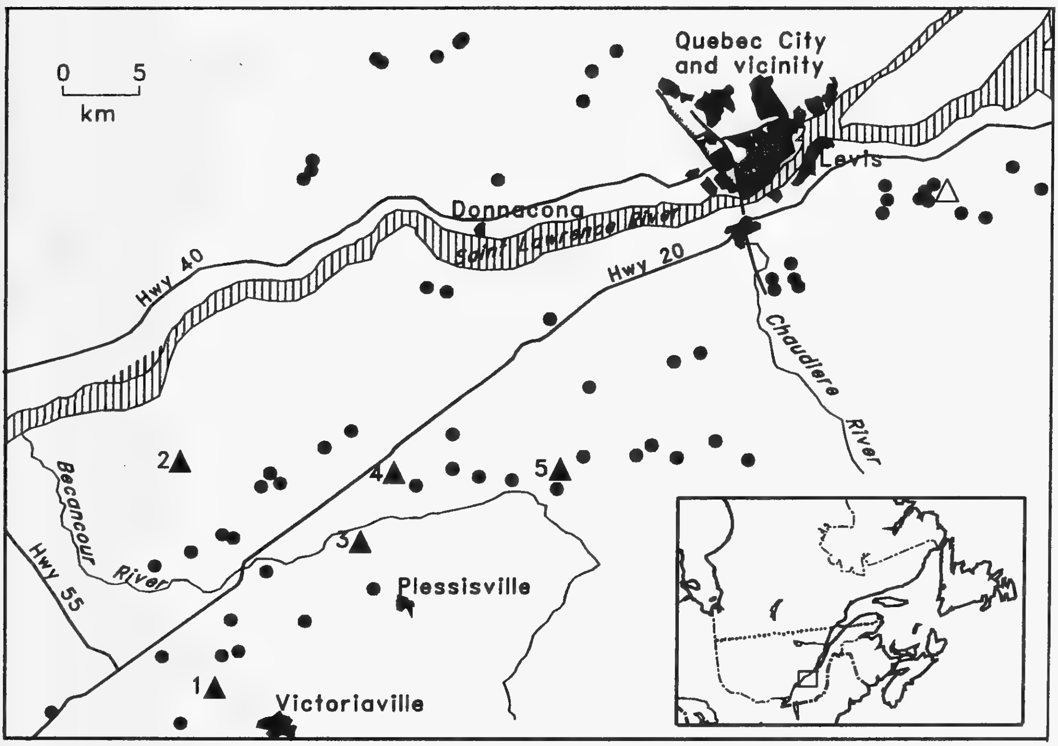


FIGURE 1. Study area in 1995. The peatlands with Upland Sandpipers are indicated by solid triangles (▲), while solid circles (●) indicate other peatlands sampled, and the empty triangle (Δ) represents the field with three observed pairs. Numbers correspond to the locatiosn on Table 1. On the inserted map, the northern limit of distribution of Upland Sandpiper in Québec is indicated by the dotted line (…), and the study area is represented by the small rectangle.

this date, the main incubation period is completed and chicks begin to leave the nest in southern Québec (Yank and Breton 1995).

To determine whether the area of the peatland had a possible influence on the presence of Upland Sandpipers, the peatlands sampled in 1995 were divided into two groups, with and without Upland Sandpipers (n = 5 and n = 27, respectively). We assume that the peatlands without Upland Sandpipers used for the analysis, had similar open habitat, based on the presence of the Savannah Sparrow (*Passerculus sandwichensis*), a species characteristic of open habitats, the habitat structure, and the interpretation of aerial photographs. We digitized 1: 15 000 aerial photographs of the peatlands to measure peatland area. We used a two-tailed t-test to compare the two groups of peatlands.

## Results

In 1994, four pairs were observed in two separate but neighboring peatlands (Table 1 and Figure 1). In 1995, 11 pairs were recorded in five peatlands (Table 1 and Figure 1), and three others in a hayfield (Figure 1). The peatlands with Upland Sandpipers were situated in a small region characterized by a mixture of lands dedicated to agriculture and forestry. Typically, these peatlands were the largest in the surrounding region, and they consisted mainly of open habitat. The vegetation was dominated either by ericaceous shrubs such as *Ledum groenlandicum* and *Kalmia angustifolia* or forbs such as *Carex* sp. Shrubs were scarce and usually found on peatland edges known as fen lags. Trees, mainly Larch (*Larix laricina*) and/or Black Spruce (*Picea mariana*), were rather rare and scattered: the overall tree cover rarely exceeded 15% (Table 1).

The results from the Student t-test show that the two groups of peatlands were significantly different ($t = 4.999$, $p < 0.0001$). The mean areas of peatlands used by the Upland Sandpipers was 375 ± 134 ha (n = 5) compared to 122 ± 98 ha (n = 27) for unused peatlands in the same region.

The birds were usually heard whistling before they became aware of us; as we approached their territories the sandpipers were visibly disturbed by our presence (Figure 2). They flew around us, calling repeatedly. These alarm calls often attracted other individuals, up to five. In peatland 4 (Figure 1), on 14 June, we also observed a chick, while an adult was performing a distraction display.

FIGURE 2. An Upland Sandpiper perched on a spruce, its wings semi-erect in an unstable position.

## Discussion

In 1995, the mean population density in the peatlands was 0.59 pairs/100 ha. This latter value could be higher if we considered only the type of habitat used by the Upland Sandpipers, thus eliminating "islands" of denser vegetation. To our knowledge, no other data are available concerning population densities in Québec. Despite the small sample size, the population density in our study was lower than the 1.1 nest/100 ha found for Upland Sandpiper in a twenty-year study conducted in Illinois (Buhnerkempe and Westemeier 1988). According to

TABLE 1. Sites of observations of Upland Sandpipers in peatlands in Quebec, and number of territories found in 1994 and 1995.

| Locality | No. | Location | Area (ha) | Vegetation cover in observation sites (%) eric. | forb | > 5m | 2-5m | < 2m | Number of territories 1994 | 1995 |
|---|---|---|---|---|---|---|---|---|---|---|
| Saint-Valère | 1 | 46°04′N;72°06′W | 160 | 90 | 2 | 0 | 3 | 2 | – | 1 |
| Sainte-Marie-de-Blandford | 2 | 46°19′N;72°11′W | 338 | 35 | 65 | 5 | 1 | 1 | – | 1 |
| Notre-Dame-de-Lourdes | 3 | 46°19′N;72°49′W | 418 | 70 | 15 | 5 | 5 | 1 | 2 | 4 |
| Villeroy | 4 | 46°23′N;72°53′W | 496 | 15 | 40 | 3 | 10 | 8 | 2 | 4 |
| Sainte-Anastasie | 5 | 46°22′N;72°35′W | 463 | 7 | 80 | 0 | 0 | 1 | – | 1 |

Osborne and Peterson (1984), an ideal habitat could support up to eight pairs/100 ha. That value was supported by a study in the Wisconsin prairies in which two Upland Sandpiper pairs had territories of 8.1 and 12.1 ha (DeGraaf and Rudis 1987).

The results show that Upland Sandpipers preferred large peatlands. The smallest peatland in which an individual was observed (160 ha) was of intermediate size, but the four other peatlands were the largest ones in the region studied in 1995. Area-sensitivity by Upland Sandpiper is not limited to peatlands: in Missouri and Illinois, Upland Sandpipers were not found in grassland habitat of less than 10 ha and 30 ha, respectively (Samson 1980; Herkert 1991). Closer to eastern Canada, Vickery et al. (1993) found a relationship between the presence of Upland Sandpipers and the area of grasslands in eastern Maine. The species was very rare in patches of habitat smaller than 50 ha, and reached an incidence of 50% in grasslands of more than 200 ha.

As with many other grassland specialists (Askins 1992), the continued loss and fragmentation of habitat may be the major cause of the Upland Sandpiper decline. On breeding grounds, urban and surburban development, afforestation on abandoned farmlands (see Askins 1992), as well as changes in agricultural practices, contribute to the loss of suitable nesting habitat. In Québec, the disappearance of traditional family-owned farms, and the extensive cultivation of corn have both been related to the decline of the species (Yank and Breton 1995).

Threats to the species are not restricted to its breeding grounds; the Upland Sandpiper also faces an important reduction of its main wintering habitat, the South American pampas. Like the North American Great Plains, the Argentinian and Urugayan pampas have been replaced by extensive crops of corn and wheat. The region's natural ecosystem has become so scarce that the outlook for its avifauna seems even more pressing than the situation of tropical forest species (Terborgh 1989).

The presence of a breeding bird may be a good indication of the suitability of a site. However, breeding success is a guarantee of its quality (Van Horne 1983) and the most important obstacle to breeding success is often nest predation (Martin 1988). Here, we experimentally measured nest predation with artificial nests in six large and relatively open peatlands of the region previously described, including Villeroy, Sainte-Anastasie and Sainte-Marie-de-Blandford. The apparent predation rate on nests averaged 12% (n = 114), with no obvious effect of distance from edge (unpublished data). This value is similar to results found by Burger at al. (1994). In their study, the rate of predation on artificial nests averaged 16.2% (n = 216) for six prairie fragments larger than 130 ha in Missouri. Our results thus suggest that peatland habitat is as suitable as grassland habitat for breeding Upland Sandpipers in Québec.

Two hypotheses may explain the lack of previous observations of Upland Sandpipers in peatlands. First, until recently, peatlands have been relatively overlooked by ornithologists and this could explain the absence of documented observations of the species in peatlands. Nevertheless, the Upland Sandpiper call and behavior make it readily detectable even by non-ornithologists. A second hypothesis is that the Upland Sandpiper has recently found new sites, along with a new suitable habitat. This plasticity would be highly valuable for the species, given the scarcity of its "traditional" habitat in northeastern America. In peatlands, disturbance by humans or predators seems rare, and there is no risk for the brood to be destroyed by farm machinery, as is often the case in fields (Ehrlich et al. 1988).

These observations, based on only two years of data, give a limited picture of the situation of the Upland Sandpiper in eastern peatlands, even though geographic coverage was wide. Consequently, they should be considered as a starting point for more investigations on the potential of peatlands for sustaining Upland Sandpiper populations, and possibly those of other grassland species.

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# Notes

## Northern Pocket Gophers, *Thomomys talpoides*, with White Pelage from Alberta

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Proulx, Gilbert, Lori Lounsbury, and Harold N. Bryant. 1996. Northern Pocket Gophers, *Thomomys talpoides*, with white pelage from Alberta. Canadian Field-Naturalist 110(2): 331.

We report the capture of two Northern Pocket Gophers (*Thomomys talpoides*) with a complete lack of integumentary pigments.

Key Words: Alberta, Northern Pocket Gopher, *Thomomys talpoides*, pelage.

The color of the pelage of pocket gophers (Geomyidae) is highly variable (Chase et al. 1982). In *Thomomys*, it varies from almost black through gray and brown to almost white; the ventral pelage is only slightly paler than the dorsal pelage (Nowak and Paradiso 1983). In Alberta, Northern Pocket Gophers (*Thomomys talpoides*) typically have a steel-gray dorsal pelage (Smith 1993); individual hairs have a brownish band toward the tip. Reports of true albinism (the complete lack of melanin pigmentation resulting in white pelage and pink eyes, Searle 1968) in *Thomomys* are rare. Burnett (1925) described a Northern Pocket Gopher (*Thomomys talpoides)* from Colorado, with a deep cream pelage, a large white throat-patch, a light tail, and almost white feet and legs. No information was provided about the eye color. Storer and Gregory (1934) reported complete albinism in three pink-eyed individuals of Botta's Pocket Gopher (*Thomomys bottae*) from California.

In May 1994, farmer D. Fear from Cremona (51° 33' N, 114° 32' W), Alberta, captured two adult Northern Pocket Gophers that were completely white from nose to tail. One was a female (Provincial Museum of Alberta accession number 95.2.1; weight 169.8 g; total length 230 mm; tail 60 mm; hindfoot 30 mm; ear 7 mm) and the other was a male (PMA 95.2.2; weight 158.1 g; total length 235 mm; tail 60 mm; hindfoot 30 mm; ear 7 mm). The animals were received frozen but the eye color was not recorded. For this reason, it is uncertain whether these animals were true albinos. Other instances of white gophers have been verbally reported to us by farmers from central Alberta. To our knowledge, these specimens are the first confirmed cases of Northern Pocket Gophers with a complete lack of integumentary pigments.

### Acknowledgments

We thank Daniel Fear of Cremona, Alberta, for bringing these white pocket gophers to our attention and for providing the specimens. Bill Weimann prepared the specimens for the Museum collection.

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# First Record of a Chum Salmon, *Oncorhynchus keta*, from the Thompson River: Adams River Spawning Grounds, British Columbia

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Welch, D. W., and J. N. Till. 1996. First record of a Chum Salmon, *Oncorhynchus keta*, from the Thompson River: Adams River spawning grounds, British Columbia. Canadian Field-Naturalist 110(2): 332–334.

The first record of a Chum Salmon (*Oncorhynchus keta*) from the upper reaches of the Fraser River, British Columbia, Canada is based on a carcass of a partly spent mature male found on the lower Adams River spawning grounds, a tributary of the South Thompson River. The record is of interest because it is a major range extension for Chum Salmon within the Fraser River drainage. The migration timing of this fish may indicate that genetic selection has occurred for a run timing significantly earlier than the norm for Fraser River chum, and may suggest that a small population of Chum Salmon is present in the Adams River area.

Key Words: Chum Salmon, *Oncorhynchus keta*, spawning grounds, first record, Fraser River, Thompson River, Adams River, British Columbia.

The Fraser River is a major producer of British Columbia Chum Salmon (*Oncorhynchus keta*), and the world's largest single producer of Pacific salmon. Although populations of all the other North American species of Pacific salmon are widely distributed throughout the Fraser watershed, populations of Chum Salmon are almost exclusively restricted to the lower reaches of the river.

Only limited records of Chum Salmon upriver of Hope, British Columbia, exist (Figure 1; Lee et al. 1980; Zallen and Farwell 1985; Farwell et al. 1987; FHIP 1990 and 1992); all are scattered observations of small numbers of Chum Salmon in creeks close to the Fraser River mainstem. Only a few hundred Chum Salmon have been recorded upstream of Hope (which lies 263 km from the river mouth at an elevation of 61 m) between 1953 and 1989 (FHIP 1992), with all but three observations lying within 60 km of Hope. The farthest upstream observation is of a total of six Chum Salmon observed in 1981-1982 in the Seton River, near Lillooet, British Columbia (Farwell et al. 1987; DFO 1990, 1992; FHIP 1992), about 140 km upstream of Hope at an elevation of 202 m (Palmer 1972). The second farthest upstream observation is of 23 Chum Salmon in Texas Creek (southeast of Lillooet), 125 km upstream of Hope, at an elevation of 213 m (Farwell et al. 1987).

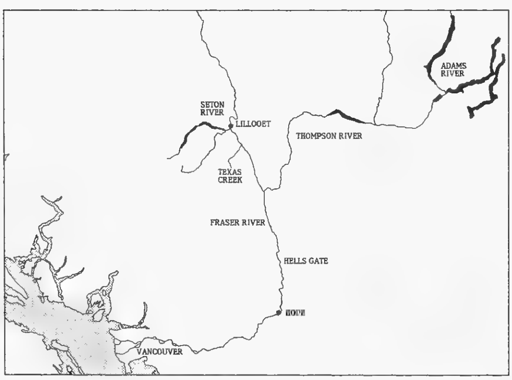


FIGURE 1. Map of the Fraser River watershed, southwestern British Columbia.

We report here the first evidence for the presence of Chum Salmon in the Thompson River, on the lower Adams River Sockeye Salmon (*Oncorhynchus nerka*) spawning grounds, approximately 483 km from the river mouth (elevation 350 m).

## Field Observations

We found a male Chum Salmon in an advanced state of decomposition on a gravel bar in the lower reaches of the Adams River spawning grounds on 29 October 1994, approximately 50 m from river entry into Shuswap Lake. Field staff from the Department of Fisheries and Oceans had first noticed the salmon several (perhaps 4 to 5) days earlier at the same location. When initially observed it had been mistaken for an unusually large male Sockeye Salmon.

The large size (73.9 cm FL, 57.5 cm postorbital-hypural length), lack of red pigmentation, and pronounced kype all suggest that the salmon was not a Sockeye (Figure 2). A scale sample confirmed the tentative identification as a Chum Salmon (Figure 3).

Examination of the gonads showed that although partly decomposed, they appeared to be partially spent, and significant abrasion of the lower lobe of the caudal fin was also evident (Figure 2).

## Discussion

Although the possibility of a hoax cannot be completely discounted, it is unlikely that this chum had

FIGURE 2. Comparison of the male Chum Salmon found on the Adams River spawning grounds (above) with a male Sockeye Salmon (below). Note the difference in size, the pronounced kype, dentition, and wear on the lower caudal fin of the Chum Salmon. Not evident in this photograph is the bright red colouration of the Sockeye Salmon; the Chum Salmon is greyish-black with slight dorsal mottling.

been carried to the spawning grounds after capture somewhere else. Several patches of white fungus were evident on the skin, a common freshwater infection in spawning salmon near death. If the fish had been caught in salt water, it is unlikely that the colouration would have been as dark as was observed, or that the fungus infection would have been as extensive. The resorption evident on the scale samples also indicates the chum had spent some time in freshwater prior to death.

The apparent extension to the distribution of Chum Salmon within the Fraser River is unusual as the Adams River spawning grounds are located up a major tributary approximately 270 km past Hope, and 483 km past the mouth of the Fraser. Chum Salmon undertake extensive (> 2000 km) river migrations in a number of large Asian and North American rivers (see review by Salo 1991); but rivers where extensive migration occur generally have relatively shallow gradients compared with the Fraser River. Immediately upstream of Hope the flow of the Fraser River is very swift because of the narrow canyon that the river must flow through.

The chum appeared to have died on the spawning grounds around 25 October (or earlier). The median survival time of Fraser River chum tagged on the spawning grounds is 10 days (Palmer 1972). Assuming (because spawning was only partially complete) that the chum arrived on the Adams River spawning grounds about one week prior to death, and that upriver migration took about 18 days (the value for Adams River Sockeye Salmon; Gilhousen 1980), freshwater entry occurred no later than the end of September.

This timing is very early compared with most Fraser River chum, which spawn in the lower Fraser from November to January (Beacham and Starr 1982; Salo 1991), and suggests that there may have been some genetic selection for an earlier than normal run timing. Indeed, if the chum was a stray born from some part of the known spawning distribution of Fraser chum, it is very unlikely that the upriver migration rate could be as rapid as that of the directed migration of Adams Sockeye to their spawning grounds, since more time would have to be spent in searching for suitable spawning areas. Combined with the extreme range extension relative to the known distribution of Chum Salmon within the Fraser River, it seems reasonable to speculate that there may be a small population of early-run Chum

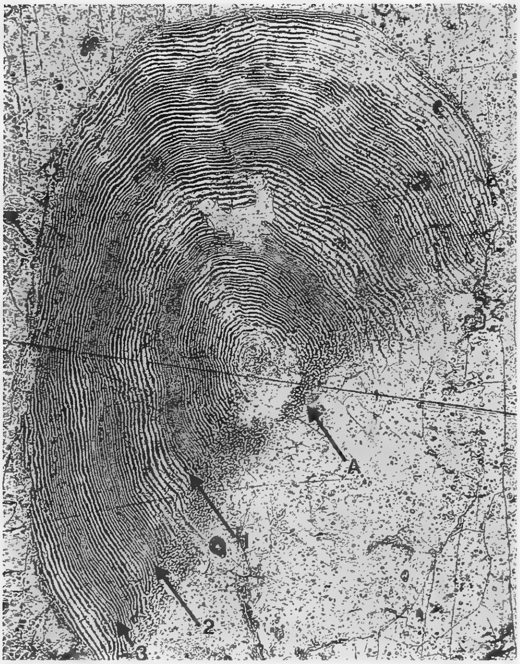


FIGURE 3. Photomicrograph of a scale taken from the preferred area of the Chum Salmon. Note the lack of a freshwater growth zone, the globular reticulations (A) characteristic of Chum Salmon (Bilton et al. 1964), and the three annuli. In addition, the overall appearance of the scale is characteristic of Chum Salmon, with a bolder, more open appearance, and broader shoulders than is evident on the scales of other species (Mosher 1969). The individual is age 0.4.

Salmon spawning on the Adams River, rather than a single male both unusually early in its run timing and far from its birthplace.

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# A Fisher, *Martes pennanti*, with Multiple Amputations

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Proulx, Gilbert, and Pamela J. Cole. 1996. A Fisher, *Martes pennanti*, with multiple amputations. Canadian Field-Naturalist 110(2): 335.

An adult male Fisher (*Martes pennanti*) captured twice, and possibly three times, in a leghold trap suffered amputations of the left hind leg at the knee joint and most of the digits of the right and left front feet.

Key Words: Fisher, *Martes pennanti*, furbearer, leghold trap, trapping, amputations, Alberta.

Fishers (*Martes pennanti*) caught in leghold traps sustain severe injuries such as broken bones and amputations (Quick 1953; Coulter 1960). From 1990 to 1993, we recorded self-mutilations and amputations in 118 (15%) out of 762 Fishers harvested in Alberta (Cole and Proulx 1994). During this study, we collected a three-legged male adult Fisher from the northeastern region. The left hind leg had been amputated at the knee level. The lesion was well healed and fibrosed over. On the right front foot, digits 1, 2 and 3 had also been amputated at the metacarpal joint and the terminal phalange of the fourth digit was missing. The injuries had healed over. The animal was captured in a leghold trap during the 1992-1993 trapping season. During this capture, it had chewed off the digit 3 terminal and middle phalanges and the digit 4 terminal phalange of the left front foot.

The amputations observed on the right front foot were similar to the fresh self-mutilations observed on the left front foot. However, because they were healed over, they likely occurred during an earlier capture. We are uncertain about the exact cause of the hind leg amputation. It could be the consequence of a bad fall or fight with another animal. On the other hand, in the northeastern region of Alberta, Number 3 leghold traps are set for Lynx (*Felis lynx*) and Coyote (*Canis latrans*), and Fishers are accidentally captured in these traps (Cole and Proulx 1994). According to Coulter (1960), these traps often break Fisher leg bones and the animals may lose part or most of a leg. This Fisher may have suffered a hind leg amputation during such a capture. On the basis of the age of the lesions, i.e., only the right front foot and the left hind leg were covered with scar tissue, and the unlikelihood that the animal could have been caught by both these limbs at the same time, we conclude that this Fisher could have been captured at three different instances in a leghold trap.

The present observation demonstrates the repetitive use by an animal of extreme measures to escape a trap in at least two instances, and the recuperative potential of a Fisher subjected to consecutive serious trauma.

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# Second Record and Possible Breeding of the Eurasian Wigeon, *Anas penelope,* in the District of Mackenzie, Northwest Territories

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Fournier, Michael A., and James E. Hines. 1996. Second record and possible breeding of the Eurasian Wigeon, *Anas penelope,* in the District of Mackenzie, Northwest Territories. Canadian Field-Naturalist 110(2): 336–337.

Eurasian Wigeons, *Anas penelope,* were observed in the Yellowknife area on seven occasions between 1990 and 1992. These included the second record of this species in the District of Mackenzie. The temporal distribution and close proximity of six of these observations suggested that breeding of Eurasian Wigeon may have occurred in the Yellowknife area during this period.

Key Words: Eurasian Wigeon, *Anas penelope*, Northwest Territories, possible breeding.

In North America, the Eurasian Wigeon, *Anas penelope,* has been recorded in virtually every state, province, and territory north of Mexico but there is no proven evidence of breeding (Edgell 1984). It is considered rarest in the westerly interior (Palmer 1976) although there are a number of records from interior Alaska (Edgell 1984). The Canadian status of this species has been defined as scarce autumn and spring transient and local winter resident (Godfrey 1986). In northwestern Canada, Campbell et al. (1990) classified it as casual in summer and autumn in interior British Columbia; in Yukon Territory it is considered rare (Anonymous 1992); and, in Alberta, Pinel et al. (1991) listed thirteen records in 1971-1980 which represent an increase in abundance over previous decades.

The first report of *A. penelope* in the District of Mackenzie was apparently erroneous. Russell (1898) supposedly collected a specimen in 1892 at the Stagg River near Yellowknife. However, Preble (1908) later noted that Ridgway had identified Russell's specimen as an American Wigeon, *Anas americana.* The first valid and apparently only record of *A. penelope* in the District of Mackenzie to date was a single male, observed by Salter et al. (1974) on 14 May 1973 on the Mackenzie River at Fort Simpson.

We observed a pair of wigeons, the male of which was positively identified as *A. penelope*, on a roadside pond about 45 km northwest of Yellowknife (62°27′N, 114°22′W) on 6 June 1990. The female was not observed well enough to detect the subtle differences separating females of *A. penelope* and *A. americana.* The latter is a common breeding species in the Yellowknife area, and mixed pairs must occur because hybrids are occasionally recorded (Watson 1970; Edgell 1984; Merrifield 1993). Regardless, this observation constitutes the second record of *A. penelope* for the District of Mackenzie.

Subsequent observations of *A. penelope* occurred on 23 and 31 May 1991. On both occasions a single male was seen on a roadside pond 32 km northwest of Yellowknife. The dates of these observations (coincident with the egg-laying period of *A. americana* in the Yellowknife area), as well as the behaviour of this male (remaining on or near the same pond for at least a nine-day period) suggested that he might have had a mate nesting in the vicinity. Another observation of a single male occurred on 1 June 1991 on Great Slave Lake approximately 5 km from the city of Yellowknife.

Further observations of *A. penelope* occurred in a third consecutive year. A single male was observed on 27 May 1992 on the same pond where the male was seen twice in May 1991. Another single male (presumably the same individual) was observed on 28 May and 3 June 1992, on a pond less than 2 km away.

No observations of *A. penelope* were reported in the Yellowknife area prior to 1990 or since 1992, although waterfowl studies have continued in the area at the same level of intensity from 1985 to the present.

All of the observations we report here, except the bird on Great Slave Lake, likely represent only one or two individuals. The remaining six observations occurred within a distance of 13 km, five of these within a distance of 2 km. In particular, it seemed highly unlikely that three observations on the same pond and two less than 2 km away, during two consecutive years, were coincidental. Rather, they suggested migrational homing by a male, or a male(s) following a philopatric female, and may constitute circumstantial evidence of breeding.

Migrational homing of waterfowl is a well-recognized phenomenon (Anderson et al. 1992). As summarized by Blohm and Mackenzie (1994), migrational homing of female ducks to natal and breeding areas has received considerable attention in the literature, whereas homing of unmated males and pairs, although known to occur, are less well documented. Anderson et al. (1992) presented data on homing rates of a variety of waterfowl. Although data for *A. penelope* were not included, data for *A. americana* indicated an approximate homing rate of 33% to

natal areas and 44% to breeding areas for females, and 8% to breeding areas for males (no data available for natal homing in males). Based on these data, it seems most probable that our observations were of a male(s) following a homing female, although we cannot eliminate the possibility of homing in an unpaired male.

There has been much conjecture over the years regarding the breeding of *A. penelope* in North America. Richardson (cited in Baird et al. 1884), suggested that it bred in northern interior Canada to 68° north. This idea was reiterated by Phillips (1923) and the evidence in its support was summarized by Hasbrouck (1944). However, Hasbrouck's argument was largely based on the supposed record of Russell (1898). Hasbrouck apparently never verified the specimen himself, nor was he aware that Preble (1908) had proven the record false. Forbush (1925, cited in Watson 1970) also believed the species was breeding in North America. In more recent literature, many authors discount (e.g. Bellrose 1976) or appear indifferent to (e.g., Johnsgard 1975; Palmer 1976) the possibility of a breeding population in North America. However, Edgell (1984), following a thorough analysis of North American records of *A. penelope*, stated; "Whether or not the wigeon is a breeding member of the American avifauna is still open to question. The possibility remains high, ..., and intermittent breeding almost to be expected from the frequency and timing of records and the regular occurrence of wintering and summering pairs." Other Eurasian species (e.g., Little Gull, *Larus minutus*, and Common Black-headed Gull, *Larus ridibundus*) have eastablished small, local breeding populations in North America in recent decades (Godfrey 1986).

Although we do not subscribe to Richardson's notion of a traditional breeding ground for this species located in subarctic Canada, we believe it likely that *A. penelope* or mixed pairs of *A. penelope* and *A. americana* occasionally breed in North America. Further, we believe breeding of *A. penelope* may have occurred in the Yellowknife area during the period 1990-1992.

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# Red Fox, *Vulpes vulpes*, kills a European Beaver, *Castor fiber*, Kit

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Kile, Nils B., Petter J. Nakken, Frank Rosell, and Sigurd Espeland. 1996. Red Fox, *Vulpes vulpes*, kills a European Beaver, *Castor fiber*, kit. Canadian Field-Naturalist 110(2): 338–339.

We observed an adult Red Fox (*Vulpes vulpes*) attack, kill and partially consume a 2-month-old female kit European Beaver (*Castor fiber*) near its lodge in Norway. The inner organs were consumed first. One adult beaver apparently attempted to frighten the fox away by tail-slapping.

Key Words: Red Fox, *Vulpes vulpes*, European Beaver, *Castor fiber*, predation, southeast Norway.

On 31 July 1994, during a beaver census in Southeast Norway (58°39′N, 7°59′E), a Red Fox (*Vulpes vulpes*) was observed killing a European Beaver (*Castor fiber*) kit (see Kile and Nakken 1995). The observer was seated with binoculars about 100 meters from the lodge. At 1930 hours a kit emerged from the lodge and started to eat Beaked Sedge (*Carex rostrata*) 15 meters from the lodge, on shore about 2 meters from the water's edge. One hour later, first a single adult, and then, several minutes later, another adult with kit emerged from the lodge and swam away. One hour and 50 minutes after the adults left an adult Red Fox approached the lodge (Figure 1). A large stone was situated between the fox and the foraging kit, so neither saw the other. The fox walked to the top of the lodge and suddenly stiffened, apparently having smelled the kit or heard it eating (the kit was still not visible). The observer could not hear the kit eating. The distance between the two animals was then about 15 meters. The fox crouched into attack position, and after a short pause attacked and killed the kit while still on shore. The struggle lasted a few seconds. The kit did not attempt to flee or fight back, apparently having been caught completely unaware by the fox. No sounds were heard from either kit or fox.

The fox dragged the kit approximately 10 meters to a flat stone under a large spruce (*Picea abies*) and proceeded to feed on the carcass. Five minutes later an adult beaver appeared and swam to the vicinity of the kill site, circling 20-30 meters from the water's edge before gliding towards the shore where the fox was feeding. The fox stood up and walked a few steps towards the adult. The beaver then tail-slapped, apparently in an attempt to frighten it, or to alert other beavers (Wilsson 1971). The fox ignored the tail-slap and returned to its prey. The adult beaver swam near the the lodge for the next 10 minutes, about 40 meters from the fox, before finally diving and disappearing. Directly after this the observer frightened the fox away and collected the remains of the kit.

The remains of the carcass weighed about 2 kg (estimated live weight at least 2.5 kg). Based on the mean parturition date for this region (Syvertsen 1976; Mörner 1990) we estimated the age at 2 months, the sex was female (see Wilsson 1971). The breast had been opened from the ventral side. The sternum, heart, lungs, stomach, cecum and both intestines had been eaten, as well as most of the liver and ribs, and part of the muscle from the right forearm. Two cervical vertebrae and 11 thoracic vertebrae were missing and apparently eaten.

Inspection of the skin revealed two puncture marks, with subdermal hemorrhaging, at the upper edge of each scapula, from the fox's lower and upper canines. The fox had bitten over the spinal column between the shoulders. Judging from the short duration of the struggle, it seems likely that the spinal cord had been severed, though direct evidence of this was not available due to the advanced stage of carcass consumption.

This is apparently the first reported observation of a Red Fox killing a beaver. Payne and Finlay (1975) reported a Red Fox attacking a beaver, but they did not observe the attack itself, and the beaver was still alive. Novak's (1987) review of the beaver mentions

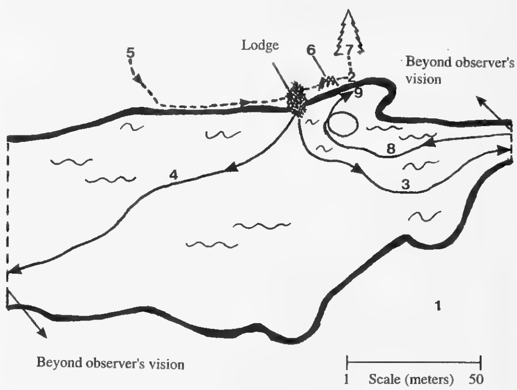


FIGURE 1. The relative positions of the observer, Fox, Beaver kits and Beaver adults in numeric order: 1) observer; 2) kit kill site; 3) single adult appears and swims away; 4) another adult and kit appears and swims away; 5) attack route of fox; 6) stone between fox and kit; 7) fox eats beaver; 8) return route of adult beaver and 9) site of tail-slapping.

the Red Fox as a predator of little importance for beaver populations. The Red Fox was not considered as a potential predator in Hill's (1982) review. Tyurnin (1984) did not record any attacks by Red Fox on beaver. Red Fox predation on beaver seems to be unusual. Only young beaver (1-2 months) are probably susceptible to fox attack while feeding on land and before having fully developed escape behavior (Wilsson 1971). Male kits are reportedly more cautious than females (Shadle 1956).

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# Polar Bear, *Ursus maritimus*, Depredation of Canada Goose, *Branta canadensis*, Nests

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Smith, Arthur E., and Michael R. J. Hill. 1996. Polar Bear, *Ursus maritimus*, depredation of Canada Goose, *Branta canadensis*, nests. Canadian Field-Naturalist 110(2): 339–340.

Evidence for depredation of four marked Canada Goose nests by Polar Bear in May 1995 on Akimiski Island, James Bay, Northwest Territories, is described. Thirty-two additional marked nests were untouched.

Key Words: Canada Goose, *Branta canadensis*, Polar Bear, *Ursus maritimus*, nest depredation.

Polar Bears (*Ursus maritimus*) have been reported to consume the eggs of Lesser Snow Geese (*Chen caerulescens*) (F. Cooch in Abraham et al. 1977), Light-bellied Brent Geese (*Branta bernicla hrota*) (Madsen et al. 1989), and eggs of unspecified or unknown origin (Römer and Schaudinn 1900; Loughrey 1956; Harrington 1965; Russell 1975), but we found no published reports documenting Polar Bears depredating Canada Goose eggs or nests. While conducting Canada Goose (*Branta canadensis interior*) nest searching on 28 May 1995, we found four Canada Goose nests on Akimiski Island, Northwest Territories, which had apparently been depredated by a Polar Bear. All four nests were within 200 m of one another along the willow (*Salix* spp.) transition zone paralleling the coastline, approximately 8 km east of Houston Point (53°12′N, 81°08′W).

Each depredated nest had been marked on 11 May 1995 with a 10 x 12 cm orange plastic flag attached to a one m wire, placed 20 m north of each nest site. At that time, the nests had clutches of two, three, four, and four intact eggs, but egg-laying was probably not complete as indicated by floating (Westerskov 1950). Additional Canada Goose nests (n = 32), within eight km in either direction along the coastline of the four destroyed nests, were also marked on 11 May but were not destroyed by Polar Bears. On 28 May, each destroyed nest had nest material and egg fragments scattered within a two m

radius around the nest bowl. Two of the nests had one egg and one nest had two eggs which were completely flattened, but were still held together by the egg membrane. These four eggs were also found within two m of the nest; the fourth nest did not have flattened eggs associated with it. Contents from the flattened eggs were not dried to the shells suggesting that they had not been broken while in or near the nest bowl. All of the nest flags showed evidence of being chewed, and the flag wires had been bent in several directions, sometimes up to 45°, and three of four wires had been pulled out of the ground.

Polar Bear tracks were clearly visible in the mud leading to and from the nests and nest flags, as well as in the general direction of the next closest destroyed nest. No other predator tracks were observed. The hind tracks were measured at approximately 18 cm wide; adult Black Bear (*Ursus americanus*) hind tracks are approximately nine cm wide (Murie 1974). It is likely that the bear visited the nests sometime after 23 May as a rain storm occurred the afternoon of 22 May and continued until mid-day on 23 May, and neither the bear tracks or egg shell fragments seemed affected by rain drops or rain-caused mud splashings. Human activities were minimized at each nest during marking and the depredation event occurred well after the last visit to the nest, therefore there was probably little, if any, human scent left at the nest sites at the time of nest depredation. There were no sightings of Polar Bears during either the 11 May or 28 May visits.

The most southern boundary of Polar Bear range occurs in James Bay near a polynya that forms south of Akimiski Island in winter (Stirling 1988: 64-65). Here the ice pack is usually completely melted by mid-July (Russell 1975), the earliest area to do so adjacent to Canada Goose nesting grounds. Upon melt, the bears move onto the mainland and islands, forming potential Polar Bear predation on geese. However, the Canada Goose nesting period in this area typically extends from early May to mid-June, making it unlikely that Polar Bears encounter many goose nests. However, fresh bear tracks have been observed in May on Akimiski Island in previous years, and a Polar Bear was encountered on the north shore of the island 24 May 1993 (J. O. Leafloor, personal communication). On 30 May 1995, Polar Bear tracks were found in close proximity to approximately 30 destroyed Lesser Snow Goose nests on the coast 25 km west (81°30′W longitude) of the depredated Canada Goose nests (S. R. McWilliams, personal communication). This observation indicates that the depredation of the Canada Goose nests in 1995 was not an isolated incident, and that when Polar Bears are present in goose nesting areas they may consume goose eggs and should be regarded as potential nest site predators. However, at this time, we do not believe that Polar Bears are major predators of goose nests on Akimiski Island.

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# Wood Turtles, *Clemmys insculpta*, in the Fresh-tidal Hudson River

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Kiviat, Erik, and James G. Barbour. 1996. Wood Turtles, *Clemmys insculpta*, in the fresh-tidal Hudson River. Canadian Field-Naturalist 110(2): 341–343.

Twelve records of the Wood Turtle, including one viable egg clutch, 1973-1995, were associated with freshwater tidal swamps on the Hudson River in New York. This is the first report of a Wood Turtle population in tidal habitat.

Key Words: Wood Turtle, *Clemmys insculpta*, estuary, fresh-tidal swamp, Hudson River, New York, wetland.

Little herpetological field work has focused on temperate estuaries which continue to be altered for industry, housing, transportation, and recreation. Reptile and amphibian use of estuaries (including freshwater tidal environments) may be limited by tidal fluctuation, salinity, water depth and breadth, currents, ice scouring, temperature, storms, predation, or pollution (Bleakney 1958: 44; Neill 1958; Dunson 1986; Kiviat 1989; Lillywhite and Ellis 1994). The Wood Turtle (*Clemmys insculpta*) is widespread in association with nontidal streams and ponds of the Hudson Valley of eastern New York. Here we report 12 records from four sites on the tidal Hudson River (Table 1).

Mean tide range is ca 1.2 m and maximum salinity < 0.1 ppt in the reaches of the Hudson River where Wood Turtles have been found. The four sites (Table 1) contain extensive complexes of intertidal and supratidal tree or shrub-dominated swamp, intertidal marsh, tidal creeks in swamp and marsh, tidal mouths of tributary streams, and upland habitats (woods and old fields). Irregularly, tidally flooded (supratidal) pools are also present at all sites except Vanderburg Cove. The supratidal hardwood swamps resemble nontidal floodplain habitats with which the Wood Turtle is associated elsewhere in the region. Beaver (*Castor canadensis*) food caches on the bottoms of tidal creeks, and the burrows of Beaver and Muskrat (*Ondatra zibethicus*) in the creek banks are possible overwintering microhabitats.

It is not clear whether the Hudson River Wood Turtles use the tidal swamp creeks as primary habitat, or if they are resident in nearby nontidal streams and move into the tidal wetlands to forage; e.g., during the unusually cold spring of 1994. Although the Hudson River Wood Turtles could have been flood-washed or human-transported, the consistent association with tidal swamp (Table 1), a habitat of restricted extent on the Hudson, suggests a resident population. A probable exception is the hatchling found in May 1973 in the tidal mouth of a tributary to the Tivoli Bays, 1100 m from the nearest tidal swamp. During the preceding two days 56 mm of rain fell, suggesting this individual was washed downstream to the estuary.

Although the geographic distribution of the Wood Turtle approaches or adjoins estuaries in 12 other states and provinces from Nova Scotia to Virginia (see range map, Ernst et al. 1994), we know of only one record of a Wood Turtle in an estuary other than the Hudson River (Parker River, Newbury, Essex County, Massachusetts, 1975, captured and released by David Taylor; Tom French, Massachusetts Natural Heritage Program, personal communication). Inclusion of Wood Turtle with the fresh-tidal marsh biota in Odum et al. (1984) was based on Kiviat (1978) (the 1974 Tivoli record, Table 1) and McCormick (1970); the latter may refer to diked (nontidal) marsh as noted by McCormick (1970) and Harding (1986: 56). The Wood Turtle is rare on the Coastal Plain compared to regions farther inland (Reed 1956; Latham 1971; Hardy 1972; Gilhen 1984; Norden and Zyla 1989; Ernst and McBreen 1991; Klemens 1993; Miller 1993). The Hudson River is the only estuary that transects the Appalachian Mountains, and the ca 130 km long fresh-tidal reach does not touch the Coastal Plain.

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TABLE 1. Wood Turtle records from the freshwater tidal Hudson River, New York. Rkm = River kilometers above the southern end of Manhattan Island (New York City); ha = approximate area in hectares of tree or shrub-dominated tidal swamp.

| Locality | N Latitude | W Longitude | Rkm | ha | Date | Class | Habitat | Observer |
|---|---|---|---|---|---|---|---|---|
| Mouth of Stockport Creek, Columbia County | 42°18′22″ | 73°46′19″ | 192 | 29 | 13 June 1994 | Adult female | Dead[1] on railroad (fill) bordered by tidal tree swamp | James G. Barbour |
| Rams Horn Creek, Greene County | 42°12′31″ | 73°51′32″ | 181 | 200 | 21 April 1994 | Adult male | Creek bank in tidal tree swamp | Erik Kiviat[2] |
| Rams Horn Creek, Green County | 42°12′00″[3] | 73°52′00″[3] | 181 | 200 | 20 June 1990 | Adult (female?) deformed front leg | Creek bank in tidal tree swamp | Deborah Berry, James Rod[2] |
| Rams Horn Creek, Green County | 42°12′00″ | 73°51′59″ | 181 | 200 | 12 May 1995 | Adult | Major creek at dirt road in tidal swamp | Deborah Berry[2] |
| Rams Horn Creek, Green County | 42°12′00″ | 73°51′59″ | 181 | 200 | 14 May 1994 | Adult male | Dirt road bordered by tidal shrub swamp and marsh, 14 m from major tidal creek | James G. Barbour[3] |
| Rams Horn Creek, Greene County | 42°11′59″[3] | 73°51′49″[3] | 181 | 200 | 30 April 1995 | Adult male[4] | Found dead, major creek in tidal swamp | Deborah Berry |
| Tivoli Bays, Dutchess County | 42°02′45″ | 73°55′23″ | 160 | 20 | 27 June 1991 | Adult | Dirt road in tidal tree swamp | William C. Nieder |
| Tivoli Bays, Dutchess County | 42°02′41″ | 73°55′44″ | 160 | 20 | 10 June 1974 | Clutch of 8 eggs[6] | Railroad (fill) bordered by tidal marsh and shallows | Donald C. Buso |
| Tivoli Bays, Dutchess County | 42°01′54″ | 73°55′44″ | 160 | 20 | ca 6 May 1983 | Adult? | On log in supratidal pool, Cruger Island[5] | William Waeys |
| Tivoli Bays, Dutchess County | 42°01′54″ | 73°55′44″ | 160 | 20 | ca 6 May 1983 | Adult? | On path, Cruger Island[5] | William Waeys |
| Tivoli Bays, Dutchess County | 42°01′02″ | 73°55′04″ | 159 | 20 | 11 May 1973 | Hatchling | Upper edge of intertidal zone, mouth of perennial tributary (Saw Kill) | Erik Kiviat |
| Vanderburgh Cove, Dutchess County | 41°52′55″ | 73°55′20″ | 142 | 1 | 30 October 1986 | Adult male missing two feet | Upland old field 5 m from tidal mouth of tributary (Fallsburg Creek) | Erik Kiviat[2] |

[1]Fragmentary remains (died in spring 1994).
[2]Photographed (Barbour examined a photograph of the 1990 Rams Horn turtle and Kiviat examined a photograph of the 1995 turtle). Plastral blotch patterns on photographs and the specimens from Rams Horn Creek indicated at least three individuals were found there.
[3]Approximate.
[4]Bard College Field Station 115.
[5]The pool is irregularly tidally flooded; the 14 ha island is surrounded by tidal waters and tidal wetlands.
[6]Incubated by Buso, 8 eggs hatched, 1 hatchling died (Bard College Field Station 103).

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# Denning Behaviour of Non-gravid Wolves, *Canis lupus*

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Wild Wolves (*Canis lupus*) that had produced pups in earlier years but were not currently pregnant, and ovariectomized captive Wolves, dug dens during and after the whelping season even though they produced no pups. These observations suggest that den digging is not a function of pregnancy or of ovarian estrogen or progesterone. We hypothesize that increasing prolactin in spring elicits or mediates den-digging behavior.

Key Words: Wolf, *Canis lupus,* den, behavior, estrogen, progesterone, prolactin, pups, pseudopregnancy, reproduction.

Because Wolves, *Canis lupus,* dig dens primarily around parturition time and use the dens almost exclusively for raising pups, den digging might be a function of reproductive hormones such as progesterone or estrogen. Apparently all mature female Wolves undergo the same hormonal changes during the luteal phase of the reproductive cycle whether gravid or not (Seal et al. 1979). The non-gravid luteal phase is known as pseudopregnancy. Presumably pseudopregnant Wolves behave similarly to gravid Wolves in seeking out and digging a suitable den, but no information about this subject has been recorded. This article reports on denning behavior of pseudopregnant Wolves as well as of ovariectomized Wolves.

Data for this study were available from two study areas, Ellesmere Island, Northwest Territories, Canada (80°N, 86°W) (Mech 1988, 1995), and Yellowstone National Park, Wyoming (45°N 110°W) (Cook 1993); and from a pack of four 2-year-old captive Wolves, including three females, at the International Wolf Center in Ely, Minnesota (48° N, 92° W).

In the first area, an identifiable Wolf, "Whitey," born in 1987 and habituated to the senior author was observed each summer 1987-1995 from > 1 m

(Mech 1988, 1995). Whitey produced pups in early June 1990, 1991, 1992, and 1994 in or near her natal den (Mech 1988, 1993; Mech and Packard 1990) and consistently remained with her pups throughout June (Mech 1995). However, in 1993 and 1995 she did not produce pups, as evidenced by close observation by the senior author. There was a lack of nipple development and she failed to localize consistently at a den.

In 1993, none of Whitey's known dens showed sign of digging or use on 2 July, and she was observed intermittently from 5 to 30 July 1993 traveling with her mate and 1992 offspring (Mech *in press*). However, Whitey visited her natal den area with her pack from 2200 hours on 13 July 1993 to 1220 hours on 14 July. Her mate even brought an Arctic Hare (*Lepus arcticus*) leveret to the den as if to give it to Whitey. However, Whitey was temporarily away from the den, and after 45 minutes, a yearling stole the Hare. Whitey lay near the den at 0002 hours, and from 0329 to 0439 hours, she dug out one entrance and entered the den six times for periods of 7–19 minutes each. She continued to sleep or rest until 1220 hours 14 July when the pack left.

In 1995, Whitey was observed away from the den on 5 July and was not observed at her natal den during three aerial checks for the senior author by Department of Defense personnel from 28 May to 29 June. None of her dens showed signs of use on 29 June, although her natal den was not checked closely on that date. On 5 July, however, Whitey was observed 8 km from her natal den and had no nipple development, contrary to her appearances during her pup- bearing years.

Whitey's natal den was freshly dug out on 4 July 1995 although no pups were present. Whitey's mate visited the den area on that date. On 5 July, Whitey visited the den at 1621 hours. She entered the den several times, inspected its various entrances, and dug it out, all for 18 minutes. Then she slept near the den from 1709 on 5 July to ≥ 0513 hours on 6 July. At 1800 hours on 5 July, Whitey's 3-year-old male offspring arrived and entered and inspected the den for about a minute. Whitey also walked into the den for a few seconds at 1829 hours on 5 July. Then the male slept near Whitey through ≥ 0513 hours on 6 July. Both Wolves were there when we left on 0513 hours but were gone at 1650 hours on 6 July and 1800 hours on 7 July.

The Yellowstone Wolf, 005F, was captured along with her mate (004M) and four young males in Alberta, Canada on 10 January, 1995. Her teats indicated that she had bred in the past (Mech et al. 1993). She and her packmates were placed in a 1-acre enclosure in Yellowstone and held for 10 weeks before being released in late March. Phillips and Smith monitored the behavior of Wolf 005F by direct observation while she was in captivity and by radio-tracking and direct observation after her release with her pack from 31 March to 31 July 1995. During confinement, 005F and 004M exhibited breeding behaviors, and a bloody discharge from 005F's vulva was apparent.

Wolf 005F first showed signs of denning behavior on 29 April. Meanwhile two other females captured in the same area at the same time as Wolf 005F and similarly transported, held, and released in the same region, produced pups about 26 April.

Wolf 005F explored Coyote (*Canis latrans*) dens several times from 29 April through 12 May. For about 2 hours on 29 April, 005F and her packmates were observed near an unoccupied Coyote den (hole 1). Her mate and one yearling spent a few minutes excavating the hole. On 3 May, the pack bedded near a second unoccupied Coyote den (hole 2), about 400 m west of hole 1. From 0615 to 0821, 005F slept at the den entrance, and from 0821 to 0830 she entered the den three times, each time disappearing for about a minute. At 0843, she entered hole 1, leaving at 0845. At 1225 hours, 005F, her mate, and a yearling bedded at a third unoccupied Coyote den (hole 3) about 4.8 km east of holes 1 and 2. Again, throughout 7 May, the entire pack was observed near holes 1 and 2, and on 11 May, 005F entered hole 1 for 8 minutes.

On 12 May, between 1750 and 1844 hours, 005F dug intensively at a fourth hole about 400 m west of hole 3. Her mate also dug for about three minutes. The hole was large, and 005F sometimes disappeared. Clouds of dust indicated that she continued to dig while out of sight. The only time 005F stopped digging is when displaced by a small herd of Bison (*Bison bison*) that approached the hole for 3–5 minutes. Wolf 005F then returned and resumed digging. At 1844 hours, 005F ceased digging and rejoined the pack which had traveled about 2.0 km east. During the next few weeks, 005F and pack remained within a few km of holes 1-4, but no more digging was seen. By early July, the pack began frequenting Pelican Valley about 32 km south of the holes.

Three female captive Wolves in Minnesota were ovariectomized by Kreeger on 6 May 1994, when about 1-year old. During spring 1995, only one of the three showed any vaginal bleeding (7–10 days), but it was light. No other courtship or reproductive behavior was apparent. On 20 and 21 July 1995, at least two of the female Wolves, not including the one that showed minor bleeding, dug a large den. (Wild Wolves use dens in this area from about 27 April through June [Mech unpublished]). These two wolves probably were completely ovariectomized since they showed no bleeding. The latter observation tends to support the report of a wild Wolf that had never ovulated but still paired with a male, held a territory, and restricted her movements for several

weeks during the denning season, although it was unknown whether she actually attended a den (Mech and Seal 1987).

The above observations suggest that den digging is not a function of pregnancy or even of ovarian estrogen or progesterone. Conceivably, the den digging could have been in response to heat, as is typical of sled dogs. However, this would not explain the Ellesmere or Yellowstone observations because heat was not a factor in those cases.

A possible endocrine-based explanation for such denning behavior may lie with rising prolactin concentrations. Prolactin, a hormone secreted from anterior pituitary lactotrophs, induces both maternal and paternal behavior in a variety of species (Zarrow et al. 1971; Dixson and George 1982; Bridges et al. 1985; Numan 1988; Gubernick and Nelson 1989). Both intact or neutered, male and female Wolves, show a strong circannual prolactin rhythm (Kreeger et al. 1991). Prolactin peaks just prior to summer solstice, coincident with whelping.

All Wolves in a pack, including unrelated members, begin feeding other pack members even before whelping (Fentress and Ryon 1982). Thus, pups are not required for this behavior. Based on these observations, it was hypothesized that increasing prolactin in spring elicits parental behavior in Wolves (Kreeger et al. 1991). Our observations of den digging by males and by females, in the absence of pregnancy or elevated progesterone or estrogen, support this hypothesis and lead us to further hypothesize that prolaction elicits or mediates den digging in Wolves.

These observations also indicate that merely seeing a Wolf at a den, or finding evidence of digging during the denning season, should not lead to the conclusion that pups were produced or will be during the current parturition season.

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# Evidence of Successful Chinook Salmon, *Oncorhynchus tshawytscha*, Spawning in the St. Lawrence River, near Cornwall, Ontario

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On 7 and 20 June 1994, two young (36.8 and 42 mm) Chinook Salmon (*Oncorhynchus tshawytscha*) were captured in the St. Lawrence River, just down-stream from Cornwall, Ontario. The specimens are attributed to natural reproduction. This is the first record of Chinook Salmon successful spawning in the St. Lawrence River and the easternmost documentation of natural reproduction of this species in the Great Lakes-St. Lawrence System.

Key Words: Chinook Salmon, *Oncorhynchus tshawytscha*, natural reproduction, St. Lawrence River, Cornwall.

The Chinook Salmon (*Oncorhynchus tshawytscha*), a species native to the Pacific Ocean, was first introduced into the Great Lakes basin in 1873 (Mills et al. 1993). A spectacular sport fishery now exists for this species in Lake Ontario (Smith 1985). Although some natural propagation is suspected, self-perpetuation is minimal and intense stocking programs have been in place since 1967 to maintain the fishery (Mills et al. 1993). Some natural reproduction has been recorded in the tributaries of the Salmon River in New York State (Smith 1985). In eastern Canada, voucher specimens (Royal Ontario Museum) of young chinook suspected to be the result of natural reproduction have been taken from several streams and rivers along the north shore of Lake Ontario. The easternmost record of chinook spawning in Canada is in Shelter Valley Creek (near Cobourg, Ontario). No record of successful spawning exists for the St. Lawrence River.

On 7 and 20 June 1994, two young Chinook Salmon (36.8 and 42 mm, respectively) were seined (minnow seine, 10 m) on the north shore of the St. Lawrence River near Cornwall, Ontario (Figure 1). Fish were identified using the key to young salmonids in McPhail and Lindsey (1970). In addition to basic salmonid features, both fish had 19 anal-fin rays (typical of Pacific salmons), a series of parr marks (8 and 10, respectively) taller than the vertical eye diameter and an adipose fin with a clear unpigmented area. The combination of the latter two characters is typical for young Chinook Salmon.

The first fish was caught in the morning of 7 June on the eastern shore of Flanigan's Point in Glen Walter, approximately 5 km east of Cornwall (45°02′00″N; 74°38′03″W). It was captured on a sandy substrate sprinkled with a few large rocks and macrophytes. Seven other species were captured in the same haul: *Fundulus diaphanus* (2 specimens), *Etheostoma exile* (3), *Notemigonus crysoleucas* (50), *Pimephales notatus* (59), *Notropis heterodon* (1), *Notropis volucellus* (2) and *Notropis heterolepis* (1). The second specimen was captured in the afternoon of 20 June on the north shore of the St. Lawrence River, just east of the city of Cornwall, approximately 1.6 km upstream of the mouth of Grays Creek (45°01′30″N; 74°40′54″W). The habitat consisted of a rubble and gravel substrate with dense algae cover on the rocks. The following fish were captured in the same seine haul: *Fundulus diaphanus* (2), *Etheostoma exile* (4), and *Pimephales notatus* (28).

Smith (1985) indicates that spawning occurs in August and September in New York State. Scott and Crossman (1973) indicate that freshwater populations may spawn in rivers flowing into lakes or on gravel shoals in the lake. Eggs (diameter: 6-7 mm; 8 000-13 600) hatch the following spring into alevins, stay two or three weeks in the nest and then become free-swimming (Scott and Crossman 1973). Adult Chinook Salmon have been caught in the Cornwall area. A large gravid female (89 cm; 9.3 kg; 5 years old) caught in November 1978 near Cornwall (45°02′N; 74°44′W) is preserved in the fish collection of the Canadian Museum of Nature (NMC 78-0372). No stocking of Chinook Salmon has been done in the St. Lawrence River and the sampling sites are situated at approximately 150 km from the east end of Lake Ontario. The small size of our specimens and the date of capture makes it impossible to infer an origin from fish that have spawned in the tributaries of Lake Ontario. Consequently, it is concluded that both specimens are direct evidence of successful natural reproduction which occurred in the fall of 1993. The location of the spawning ground is unknown but it seems most parsimonious to infer that it has occurred somewhere along the north shore of the St. Lawrence River near Cornwall. Dumont et al. (1988) indicated that the furthest downstream report of a Chinook Salmon in the St. Lawrence River was at Pointe-au-Père, near Rimouski, in 1986. Spawning of Chinook Salmon

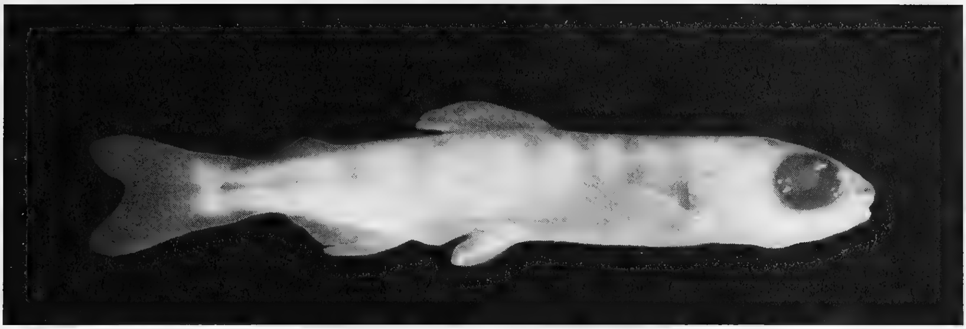

FIGURE 1. Young Chinook Salmon (*Oncorhynchus tshawytscha*) captured in the St. Lawrence River, near Cornwall (NMC 95-002; 36.8 mm).

was observed in the St. Lawrence River, 30 km upstream from Montreal (Dumont et al. 1988) but no evidence of successful reproduction (survival of young) was reported. This is, therefore, the first documented record of Chinook Salmon natural reproduction in the St. Lawrence River and the easternmost of successful natural reproduction for this species in the Great Lakes-St. Lawrence System.

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# Apparent Longevity Records for Red Foxes, *Vulpes vulpes*, in Labrador

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Two Red Foxes (*Vulpes vulpes*), trapped in November 1994 near Goose Bay, Labrador, were aged at 8 years 7 months and 10 years 8 months. These two ages exceed the oldest record in the literature by 1 month to 2 years 3 months, respectively.

Key Words: Red Fox, *Vulpes vulpes*, age, annuli, Labrador.

Red Foxes, *Vulpes vulpes*, are important to wildlife managers because of their ecological role as predators, their aesthetic, recreational and fur value, and their role in disease transmission (Allen and Sargeant 1993). Although researchers have concentrated on feeding habits (Sklepkovych 1994), reproductive patterns (Smits and Slough 1993), and dispersal (Allen and Sargeant 1993), most studies have recorded very low frequencies (< 3 percent) of foxes in older (> 5 years) age classes.

Red Foxes have been commonly aged at 5 to 7 years (Allen 1984; Allen and Sargeant 1993) and some have exceeded 7 years. Storm et al. (1976) found in their study of a midwest fox population only two (1M, 1F) foxes to survive 6 years and only 3 percent of 1987 Red Foxes were trapped 3 to 6 years after tagging. Allen and Sargeant (1993) reported Red Foxes being recovered up to 8.6 years after being tagged as pups, of which four foxes (3F,1M) were recovered > 7 years after being tagged. It appears that the 8.5 year old female fox (Matsons 1991*) recovered by Tullar (1983), 7 years after tagging, is the maximum reported age of a live captured Red Fox. Female foxes surviving > 2 years may be especially important to populations because of age-related increases in reproductive performance (Allen 1984; Allen and Sargeant 1993).

On 12 November 1994, a cross colour phase, female fox was snared by Phillips near Canadian Forces Base, Goose Bay, in south-central Labrador (53°22.44′N, 60°27.27′W). Seventeen days later on 29 November 1994, Phillips snared a silver colour phase, male fox approximately 15 m from the first capture location. Both foxes, especially the male, exhibited excessive tooth wear. The skulls of both specimens were retained. Lower canines from both foxes were extracted and aged using cementum annuli (Matson's, Milltown, Montana). Ages as of their last birthdays were reliably determined at 8 years for the female and 10 years for the male (Matson 1991). Both age determinations were given a "A" rating (90% accuracy) or ± 1 year for the 8 to 15 year age category. If we arbitrarily assign an average birth date for fox cubs in this area of 1 April, the ages of the female and male at death were 8 years 7 months and 10 years 8 months, respectively.

Mounted slides displaying longitudinal tooth sections of each canine (Catalogue Number NFM MA-80.1 [female cross]) and NFM MA-81.1 [male silver]) and the skulls (Catalogue Number NFM MA-80.2 [female cross] and NFM MA-81.2 [male silver]) have been deposited in the Newfoundland Museum of Natural History.

*See Documents Cited section before Literature Cited.

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# Observation of Repeated Use of a Wolverine, *Gulo gulo*, Den on the Tundra of the Northwest Territories

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Lee, John, and Allen Niptanatiak. 1996. Observation of repeated use of a Wolverine, *Gulo gulo*, den on the tundra of the Northwest Territories. Canadian Field-Naturalist 110(2): 349–350.

The use of the same small area for denning by one or more Wolverines over three consecutive years is reported.

Key Words: Wolverine, *Gulo gulo*, denning, Northwest Territories.

Although several studies have occurred in recent years (Hornocker and Hash 1981; Magoun 1985; Gardner 1985; Whitman et al 1986; Banci 1987) there are many gaps in our understanding of Wolverine ecology. For instance, little is known of Wolverine denning requirements or of the distribution of dens on the landscape (Banci 1994).

Wolverine dens can vary from simple rest beds to complex natal dens with extensive tunnel networks (Pulliainen 1968; Magoun 1985). Natal dens are found in a variety of habitats, and in tundra and alpine situations are frequently associated with rocky scree slopes and large snowdrifts (Magoun 1985; Bevanger 1992). Although Inuit hunters have reported active Wolverine dens in the same location over several years (A. Niptanatiak, unpublished data), we are unaware of published reports describing annual den or denning area fidelity. We report on the repeated use of a Wolverine den site over three years.

We located a Wolverine den in April 1993 on the tundra of the Northwest Territories, approximately 160 km southeast of Coppermine (latitude 66°30′N, longitude 113°00′W). The den was in a large hard-packed snowdrift on the lee side of a south easterly facing rock outcrop. The snowdrift extended from the top of the rock face to a lake shore, a vertical distance of approximately 25 m and a horizontal distance of 100 m. There was an opening at the very top of the drift and one lower down the slope approximately 75 m away, almost at the lake shore. Several sets of fresh Wolverine tracks came and went from both openings. Many sets of older tracks were evident in the vicinity. We visited the site briefly every few days over the next three weeks and always encountered fresh tracks.

In March 1994 we revisited the area and found the den again active. The two den openings were in the same positions as in 1993 and Wolverine tracks were evident entering and leaving both openings. Tracks of various ages were present in the area. We followed a set of fresh tracks leading from the den and captured an adult female Wolverine. As the Wolverine was pursued, she headed directly toward the den and was captured less than 1 km from it. She did not appear to be lactating or pregnant. There was no way of knowing if this Wolverine was the same animal which used the den in 1993.

In August 1994, we again visited the area. With snow absent, the ground beneath the rock face was a jumble of angular boulders varying in diameter from about 40 cm to several metres. Under some of the overhangs created by the boulders was evidence of rudimentary beds pressed in the lichen and grass. Scattered between the positions where the upper and

lower openings had been were several places where scats and food remains were concentrated. The remains varied in age from recent to very old, suggesting that this site may have been used over many years.

In March 1995, we again visited the site. A den was located approximately 300 m north of the originally described den on the same rock face. No Wolverines were observed but fresh tracks and numerous older tracks were observed. Only one opening was evident.

The numerous tracks in the vicinity, the repeated use of the same area for denning over three years of observation, the apparent extent of the den, and the presence of an adult female would suggest that this may have been a natal den site.

Denning habitat on the Canadian tundra should not be limited because rocky outcrops and extensive snowdrifts abound. Although we were unable to confirm the den was used by the same Wolverine in all three years, this den site was used each spring. On the tundra, Arctic Foxes (*Alopex lagopus*) (Macpherson 1969) and Wolves (*Canis lupus*) (Mech and Packard 1990) often reuse dens in successive years.

In northwestern Alaska, Magoun (1985) located several Wolverine natal dens, four of which were used by the same female over four years. Although these four dens were not in the exact location, they were within 1 to 2 km of each other, or all within approximately 4 $km^2$ (Magoun, personal communication 1995). In one year no kits were produced and the den was abandoned. In the years when kits were present, this female's home range during the denning/summer period was calculated at 56 and 99 $km^2$ (Magoun 1985). The area chosen for denning, consequently, represented about 4% to 7% of her home range. Considering that the home ranges of adult females with young may be exclusive (Magoun 1985) and that the number of adult males are related to the number of females (Magoun 1985; Banci 1987), the number and distribution of natal dens could have potential to provide an indication of the density of resident Wolverines on the tundra.

In view of increased mineral exploration occurring on the tundra of the Northwest Territories, questions of Wolverine den site fidelity are pertinent. Answers to such questions are just a small part of Wolverine ecology that should be understood to allow assessment and mitigation of impacts as development proceeds.

**Acknowledgments**
I thank J. Nishi for his contributions toward logistics and funding and K. Poole for his helpful comments on the manuscript.

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# Home Range Size of Bushy-tailed Woodrats, *Neotoma cinerea*, in Southwestern Alberta

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Topping, Michael G., and John S. Millar. 1996. Home range size of Bushy-tailed Woodrats, *Neotoma cinerea,* in southwestern Alberta. Canadian Field-Naturalist 110(2): 351–353.

The home range sizes of Bushy-tailed Woodrats (*Neotoma cinerea*) in the Canadian Rockies, were measured over a three year period (1992-1994) by means of radio telemetry. Males had significantly larger mean home ranges than females (6.12 ha and 3.56 ha respectively), but there were no differences within each sex between years. Home range sizes from this study were >20 times larger than home ranges reported for other species of *Neotoma*. The proportionately larger home ranges of Bushy-tailed Woodrats may be due to their reliance on fissures within rocky outcrops for den sites.

Key Words: Bushy-tailed Woodrat, *Neotoma cinerea*, den site, home range, radio telemetry, Alberta.

Woodrats (*Neotoma* spp.) occupy habitats ranging from boreal woodland to desert and thornscrub (Vaughan 1990). Two habitat requirements common to all members of the genus are succulent plant food (at least 50% water by weight) and shelter, provided by rocks, shrubs or trees (Finley 1958; Vaughan 1990). Energy conserving adaptations such as small litter size (Vaughan and Czaplewski 1985), late maturation (Egoscue 1962) and storage of food (Atsatt and Ingram 1983) are common in this genus. Reliance on shelter provides a further method of conserving energy in woodrats. The majority of *Neotoma* species construct nests from sticks, twigs, leaves and bones (Finley 1958) which provides protection from both predators and temperature extremes (Brown 1968; Vaughan 1990). This reliance on a nest and protected den site has resulted in the majority of *Neotoma* species exhibiting a den-centered ecology, with small home ranges and central place foraging (Raun 1966; Finley 1990). However, the majority of studies on foraging ecology of *Neotoma* have been performed on species inhabiting the central or southern areas of North America (Fitch 1947; Murphy 1952; Hamilton 1953; Finley 1958; Findley et al. 1975). As such, little is known about the home range size and foraging ecology of the more northern species of woodrat, *Neotoma cinerea.*

The Bushy-tailed Woodrat (*Neotoma cinerea*) is the largest and most northerly living of the genus, reaching a weight of up to 500g and inhabiting the mountainous regions of Western North America, as far north as the southern Yukon, and as far south as northern New Mexico (Finley 1958). They utilize fissures in rocky outcrops for den sites (Finley 1958; Escherich 1981; Hickling 1987). We measured the home range sizes of Bushy-tailed Woodrats over three breeding seasons in the Kananaskis Valley, southwestern Alberta (51° N, 115° W). Woodrats from four adjacent rocky outcrops (elevation: 1670 m.a.s.l.) were monitored by weekly live trapping and radiotelemetry between late April and August of 1992-1994. Outcrops were surrounded by mature mixed coniferous (White Spruce, *Picea glauca*, Douglas Fir, *Pseudotsuga menziesii*, and Lodgepole Pine, *Pinus contorta*) forest with a mixed shrub understory (Bearberry, *Arctostaphylos uva-ursi*, Common Juniper, *Juniperus communis*; Buffaloberry, *Sheperdia canadensis*; and *Ribes* spp.).

Positional data were gathered from live trapping and radio telemetry. Tomahawk live traps were set at fixed locations along the base of each outcrop every week. Depending on the length of the outcrop (170 – 300 m) 20–40 traps were set each night. Live trapping provided demographic data, and allowed radiocollars (Model No. PD-2C, Holohil Systems Ltd., Ontario) to be fitted to reproductively active individuals. Radio telemetry was carried out once per week on each outcrop, from 0000 – 0400 hrs. We scanned the range of radiocollar frequencies at 10 minute intervals, and recorded data on the signal strength, and direction from a telemetry station of known and fixed position. The receiver was calibrated for distance, allowing the position of the animal to be plotted on a scale map of the study area.

By plotting an observation area curve, we determined that a minimum of 14 independent locations were required to accurately represent the home range size. Therefore, we only used data from individuals that had 14 or more locations. We determined home range size for 5 males and 9 females in 1992, 8 males and 9 females in 1993, and 10 males and 8 females in 1994 using the Minimum Convex Polygon method, from the RANGES IV program (Kenward 1990). In all years, males had significantly larger home ranges than females ($F=9.31$; $df=1,43$; $p=0.004$), but home ranges within each sex did not differ between years ($F=2.14$; $df=2,43$; $p=0.130$) (Table 1).

In comparison to home range sizes from other species of *Neotoma*, which range from 0.1-1.08 ha

TABLE 1. Mean (±SE) home range sizes of male and female Bushy-tailed Woodrats during 1992-1994. Sample sizes are in parentheses; minimum and maximum are shown below mean values.

| Year | Male Home Range size (ha) | Female Home Range size (ha) |
|---|---|---|
| 1992 | 5.49 ± 1.48 (5) | 3.13 ± 0.65 (9) |
| | (1.59 - 9.18) | (1.65 - 6.90) |
| 1993 | 5.10 ± 0.84 (8) | 3.15 ± 0.82 (9) |
| | (1.93 - 10.06) | (0.13 - 7.43) |
| 1994 | 7.26 ± 0.70 (10) | 4.44 ± 1.33 (8) |
| | (3.84 - 11.19) | (0.91 - 10.44) |

(Johnson 1952; Goertz 1970; Cranford 1977; Vaughan and Schwartz 1980; Kelly 1989; Lynch et al. 1994), home range sizes from this study were much larger (Table 2). This variation in home range sizes within *Neotoma* species may be a reflection of the productivity of the habitat, since larger home ranges are often indicative of lower productivity (Harestad and Bunnell 1979). However, no information is available on the relative degree of productivity in the habitats occupied by members of the genus *Neotoma*, so we were unable to determine whether variation in productivity between habitats could be one cause of the variation in home range sizes.

The larger home range sizes may also be a direct consequence of *N. cinerea* requiring existing fissures in rocky outcrops for den sites. *Neotoma* species that are able to manipulate or alter the environment in order to create den sites are not dependent on existing geographic structures for den sites, and may establish their nests in close proximity to other resources, resulting in small home ranges (Table 2). A suitable den site for *N. cinerea* may be located at considerable distances from other necessary resources. Therefore, *N. cinerea* may require large home ranges in order to have access to all requirements for survival. The benefits of occupying an appropriate den site (which may be located at some distance from other resources) may outweigh the costs of maintaining a large home range.

## Acknowledgments

J. Goddard, J-P. Bechtold and N. Swerhun provided valuable assistance in the field. Thanks also to T. Teferi for advice on radio telemetry at the start of this study. The University of Calgary Kananaskis Field Station provided facilities which allowed the undertaking of this study. M. Chase provided critical review and discussion on earlier drafts of this manuscript. This study was supported by a Commonwealth Scholarship to M. Topping and a Natural Sciences and Engineering Research Council of Canada grant to J. Millar.

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TABLE 2. Mean Home Range size (ha) of males and females for five species of *Neotoma*. The method by which data was collected is also shown.

| Species | Male Home Range | Female Home Range | Method of data collection | Source |
|---|---|---|---|---|
| *N. floridana* | 0.26 ha | 0.17 ha | Live Trapping | Goertz (1970) |
| *N. fuscipes* | 0.23 ha | 0.19 ha | Telemetry | Cranford (1977) |
| | 1.08 ha | 0.05 ha | Telemetry | Kelly (1989) |
| | 0.44 ha | 0.36 ha | Telemetry | Lynch et al. (1994) |
| *N. lepida* | 0.34 ha | 0.11 ha | Nocturnal tracking | Vaughan and Schwartz (1980) |
| *N. micropus* | 0.10 ha | 0.13 ha | Live Trapping | Johnson (1952) |
| *N. cinerea* | 6.12 ha | 3.56 ha | Trap/Telemetry | this study |

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# News and Comment

## Errata: *The Canadian Field-Naturalist 109(3)*

**Pringle, James S.** 1995 [1996]. The history of the exploration of the vascular flora of Canada 109(3): 291-356

On page 333, right column, lines 49 and 50. "Live" should deleted and replaced by "Luc". "Saucier" should be deleted and replaced by "Goulet".

On page 352, right column, line 40, "Saucier" should be deleted and replaced by "Goulet"

**Pringle, James S.** 1995 [1996]. The history of the exploration of the vascular flora of Greenland. Canadian Field-Naturalist 109(3): 362-375.

On page 368, two lines of text are missing from the bottom of the right column, add: "ing the 1930s have been cited by Adams and Norwell (1936) and Kleppa (1973)."

**Pringle, James S.,** *Compiler*. 1995 [1996]. Combined index to personal names. Canadian Field-Naturalist 109(3): 378-382.

On page 379, right column, after line 42, insert "Goulet, I. 333"

On page 381, right column, line 11, delete "Saucier, I. 333"

Thanks to Jacques Cayouette, Agriculture and Food Canada, Ottawa.

FRANCIS R. COOK

## *Rana-Saura*: Amphibian Follow-up Project: Atlas of Amphibians and Reptiles of Quebec

Volume 2, number 2, December 1995, of the newsletter of the *Atlas of Amphibians and Reptiles of Quebec* project contains a summary of the third session (1995) results. Compared to 1994 there was a 44% increase in participation to 56 people. Also included is an analysis of road surveys in 1993 and 1994 and "End of Season" comments for 1995 with a full list of participants. The recently published *Atlas of Amphibians and Reptiles of Quebec* (reviewed in *The Canadian Field-Naturalist* 109(4): 493, 1995) is described. The newsletter is produced by the St. Lawrence Valley Natural History Society, with the assistance of the Ministère de l'Environnement et de la Faune, Quebec. Copies of the Atlas are available from the Society at $12 per copy plus $3 for postage and handling (in United States funds for U.S. orders).

SYLVIE MATTE

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## *Sea Wind*: Bulletin of Ocean Voice International

*Sea Wind*, volume 9, number 3, pages 1 to 36, July-September 1995 has a feature article on "Offshore and deep-sea marine reserves and Parks: A major gap in protected area networks" by D. E. MacAllister who also contributed "Advisory body to Biodiversity Convention" covering the Subsidiary Body for Scientific, Technical and Technological Advice (SBSTTA) created to provide advice to the Conference of Parties of the Biodiversity Convention. T. E. Reimchen of the University of Victoria has written "Estuaries, energy flow, and biomass extraction in Gwaii Haanas" [South Moresby] National Park Reserve in British Columbia.

*Sea Wind*, volume 9, number 4, October-December 1995 is a special issue on the Status of the World Ocean and its Biodiversity by D. E. McAllister covering I. Status of Biodiversity, Biological Resources and Conservation Initiatives, II. Strategies and Action. There is a seven page reference section to round out this largely point-form comprehensive discussion.

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## FROGLOG: IUCN/SSC Declining Amphibian Populations Task Force

The December 1995 issue (number 15) of the newsletter of the Declining Amphibians Task Force (DAPTF) sponsored by the World Conservation Union (formerly called the "International Union for the Conservation of Nature" - IUCN), Species Survival Commission (SSC), contains an update on the North American Monitoring Program, Abiotic Disturbances in the Lesser Antilles, Biological Control of the Cane Toad *Bufo marinus* in Australia, Observations from Long-term Population Studies in Switzerland, US Regional Group Meetings, Publications of Interest, and a list of New Working Group Chairs and some address changes. There is also a plea for donations to continue the work of the Decline in Amphibian Populations Task Force. The editor is John Baker, Department of Biology, The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom.

The February 1996 issue (Number 16) is entirely devoted to an overview of some of the work being conducted in Canada on amphibian populations, including a summary of the 1995 Decline in Amphibian Populations in Canada (DAPCAN) fifth annual meeting. This issue has been guest edited by Christine Bishop of the Canadian Wildlife Service who has been a major force in the success of DAPCAN since its inception at a workshop held in Burlington, Ontario, in the fall of 1991.

The May 1966 issue (Number 17) features News from South Asia, Aliens Exterminate Amphibians, DAPCAW VI and The Boreal Dip Net, US Great Lakes Declining Amphibians Conference, Southwestern US Working Group/NAAMP Documents Web Meeting, Earthwatch Funding, Endangered Species Bulletin, More Donations to Task Force, Meetings, Publications of Interest, and New PAPTF Working Group chair.

Further information on the Declining Amphibians Task Force and copies of its newsletter FROGLOG are available from:

STEPHEN CORN

Task Force Chair, Midcontinent Ecological Science Center
4512 McMurry Avenue, Fort Collins, Colorado, USA 80525-3400

FROGLOG can also be found on the World Wide Web at the following URL: http://arcs-info.open.ac.uk/info/ newsletters/FROGLOG.html

## Bullfrog Management in Ontario: Workshop Proceedings

The Southern Region Science and Technology Transfer Unit of the Ontario Ministry of Natural Resources has printed *Bullfrog Management in Ontario: Workshop Proceedings*. This is the result of session held 3 October 1994 at which invited presentations were given by Francis Cook (Bullfrog life history), Bob Johnson (Global perspective on amphibians), Michael Berrill (Ontario Bullfrog perspective), Ron Brooks (Amphibian monitoring and Bullfrog research), Hans von Rosen (Eastern Ontario Bullfrog management perspective) and Ross Cholmondeley (Bullfrog management program summary - 1994). Some highlights from the original verbal presentations are summarized in point form and followed by excerpts from three discussion groups on Monitoring, Research and Experimental Management Needs, and Bullfrog Harvest. The focus of the session was an examination of reported Bullfrog declines in Ontario and the possible causes and solutions. The most important resulting action in the short term was the suspension of commercial Bullfrog harvest in Ontario in 1995.

The most useful inclusion is the 1994 Program Summary which makes available the results of surveys and questionnaires in eastern Ontario in tabular and graph form (by Ross Cholmondeley, co-editor with K. Coleman). Texts were apparently transcribed from oral presentations by uncredited Ministry staff and not proof-read by presenters, hence a few slips in delivery or transcription that otherwise might have been detected before publication have been included, such as the lapsus credited to me that there are 4000 species of amphibians in North America (a total which actually applies to the whole world). [Future printings will be corrected]. Another discordant note is the cover picture of a stylized frog with dorsolateral folds, a feature which is uniquely *absent* in Bullfrogs among Canadian ranid frogs. Copies are available from the Ontario Ministry of Natural Resources, Southern Region Science & Technology Transfer Unit, Oxford Avenue, Box 605, Brockville, Ontario K6V 5Y8.

FRANCIS R. COOK

## Frogwatch 96

In Nova Scotia, the Frogwatch program is to be continued for a third consecutive year. In 1994 a pilot project was instigated and in 1995 this was expanded to be province-wide. Both seasoned "Peeper seekers" and newcomers in Nova Scotia are invited to participate in the 1996 efforts. These began in mid-March with the listening for, recording and reporting of Spring Peeper (*Hyla crucifer*) calls. This will run through to mid-June. As well, wet places where amphibians live will be studied though the summer. For more information, participation forms and kits, please contact: Frogwatch 96 c/o The Nova Scotia Museum of Natural History at address, phone, fax or e-mail given below.

Frogwatch 96 is a partnership of the Nova Scotia Museum of Natural History, The Clean Nova Scotia Foundation, Envirosphere Consultants Ltd, and is also supported by Wildlife Habitat Canada, Canada Trust Friends of the Environment Foundation, Environment Canada, The Nova Scotia Department of Education, and Seagull Pewter.

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## The Second Annual International Symposium on Biology and Conservation of Owls of the Northern Hemisphere

The Second Annual International Symposium: Biology & Conservation of Owls of the Northern Hemisphere is scheduled for 5-9 February 1997 at the Delta Winnipeg Hotel, Winnipeg, Manitoba under the auspices of the Manitoba Department of Natural Resources. International enquiries have indicated that a second symposium (the first was also sponsored by the Manitoba Department of Natural Resources in February 1987) 10 years later would provide a welcome forum for discussion of progress in biology and management of owls and their habitats and presentation of the accumulated research results. Included will be the 62 species (in 19 genera) of owls recognized as occurring in the Northern Hemisphere in K. H. Voous 1988 (*Owls of the Northern Hemisphere*. William Collins & Co. Ltd., London. 320 pages). Features of the meeting will include Scientific Paper Sessions, Poster Sessions, Workshops, Field Trips, Exhibits and Owl Art Display, Films and Videos, Banquet and Social Gatherings. Blocks of rooms have been reserved at a special rate at the Delta Winnipeg Hotel. Details on program availability and preparation and submission of abstracts are available form the addresses below.

DR. JAMES R. DUNCAN
Chair, Program Committee
DR. ROBERT W. NERO

Manitoba Conservation Data Centre, Department of Natural Resources, 200 Saulteaux Crescent, Winnipeg, Manitoba, Canada R3J 3W3 * Phone 204-945-7465 (Duncan) * 204-945-6817 (Nero) * Fax 204-945-3077 (both); e-mail owl@envirolink.org

## Second International Conference on Raptors

The Raptor Research Foundation's Second International Conference on Raptors will be held at the University of Urbino, in Urbino, Italy, 2-5 October 1996. It will cover all aspects of the study and conservation of birds of prey throughout the world.

Also associated with this event is an important international symposium entitled "Raptors and Energy Development", that will take place during the conference on 3-4 October 1996. This symposium will address the interaction of birds of prey and wildlife in general with energy-related infrastructure and activities, as well as their impact, management and regulation. For additional information on this symposium contact one of its co-chairs, Thomas E. Krueger (address below) or Dr. Patricia L. Kennedy, Colorado State University, Department of Fish and Wildlife Biology, Colorado Springs, Colorado (970-491-6597; Fax 970-491-5091).

The conference will also include a symposium on the status and conservation of Italian raptors, round-tables on various timely topics, moderated film and video sessions, local field trips, and the possibility for attendees to participate in longer cultural and nature tours, as well as tours of Urbino itself.

Tentatively planned are the following scientific sessions along with the General Session: Applied Behavioral Ecology, Asian Raptor Studies, Conservation and Management Techniques, Genetics, Migration and Dispersal, Patterns of Raptor Diversity in South America, Population Ecology, and Toxicology. Papers and poster will be presented either in English and Italian.

The deadline for receipt of abstracts in 1 August 1996. Contact the Conference Committee Chairperson Massimo Pandolfi, Instituto de Sciencze Morfologische, Via Oddi 21, 61029 Urbino, Italy *Phone +39-722-328033 *Fax +39-722-329655) for more information or to submit abstracts.

THOMAS E. KRUEGER, JR.

Scientific Director, The Italian Raptor Association, Via Eulambio, 14/A, 34072 Gradisca d'Isonzo (Gorizia), Italy *Phone: +39-481-960918 *Fax: +39-481-99876

## Recovery of Nationally Endangered Wildlife in Canada (RENEW)

The latest recovery plan for an endangered Canadian species was mailed in February 1996. Earlier notices for this series appear in *The Canadian Field-Naturalist* 109(1): 124 (numbers 1 to 11) and 109(2): 266 (numbers 12 and 13). The new report is:

*National Recovery Plan for the Newfoundland Martin.* RENEW Report Number 14. 29 pages. dated "August 1995".

Available from: Recovery of National Endangered Wildlife, Ottawa, Ontario K1A 0H3.

CANADIAN WILDLIFE FEDERATION

2740 Queensview, Ottawa, Ontario, Canada K2B 1A2

## RENEW: Fifth Annual Report 1994/1995

The Fifth Annual Report 1994/95 of the Recovery of National Endangered Wildlife (RENEW) [Canada] is now available from the Canadian Wildlife Service (34 pages). It contains an explanation of what RENEW is, a From the Chair introduction by David R. Bracket; RENEW at the Crossroads; Cross-Canada check-up: species *with* and species *without* approved recovery plans; Finance: funding by species, list of donors; Profiles: Dale Hjertaas; Theresa Aniskowicz, Cormick Gates; The recovery teams; For more information (where and how to obtain, by province); RENEW members (federal and provincial departments and societies). An insert is titled "1994 List of Species at Risk Designated by the Committee on the Status of Endangered Wildlife in Canada", and contains all species designated Extinct, Extirpated, Endangered, Threatened, and Vulnerable up to, and including, the annual meeting of COSEWIC annual meeting of two years ago.

SIMON NADEAU

RENEW Secretariat, c/o Canadian Wildlife Service, Environment Canada, Ottawa, Ontario, Canada K1A 0H3

## Canadian Wildlife Service LRTAP Biomonitoring Program

*Part 2, Food chains monitoring in Ontario lakes: Taxonomic codes and collections* by D. K. McNicol, M. L. Mallory, and B. E. Bendell. 1996. Canadian Wildlife Service Technical Report Series number 246. 32 pages.

This is the second in a series describing ongoing research and monitoring activities of the Canadian Wildlife Service Long Range Transport of Air Pollutants (LRTAP) Biomonitoring Program from 62 small lakes and wetlands in the Algoma, Muskoka, and Sudbury regions of Ontario sampled on a regular basis for various prey of resident waterfowl. Many of these prey are acid-sensitive and absent from lakes degraded by acid precipitation. This report contains information on locations, methods, and timing of collections and summarizes the macroinvertebrate, fish, and amphibian taxa taken between 1987 and 1994. There is a valuable biography in which 25 of 45 items included are earlier aspects of this large study coauthored by one or more of the present authors. Other reports in this series include:

*The Canadian Wildlife Service LRTAP Biomonitoring Program Part 1. A strategy to monitor the biological recovery of aquatic ecosystems in Canada from the effects of acid rain.* Canadian Wildlife Service Technical Report Series number 245. 28 pages.

*The Canadian Wildlife Service LRTAP Biomonitoring*

*Program Part 3. Site locations, physical, chemical and biological characteristics*. Canadian Wildlife Service Technical Report Series number 248.

For more information on the CWS LRTAP Biomonitoring Program or to obtain copies of any of the reports in the series please contact:

DONALD K. MCNICOL

Environment Canada, Environmental Conservation Branch, Canadian Wildlife Service, Ontario Region, 49 Camelot Drive, Nepean, Ontario, Canada K1A 0H3

## Newsletter of the Biological Survey of Canada (Terrestrial Arthropods)

One of the outstandingly successful and continuing initiatives in advancing the description and analysis of Canada's fauna is the Biological Survey of Canada (Terrestrial Arthropods) which coordinates research projects and effectively serves as communication centre for those conducting original work on arthropods in Canada. Its latest newsletter (volume 15, number 1, spring 1996) includes a summary of a meeting of the Scientific Committee for the Biological Survey of Canada (Terrestrial Arthropods, October 1995; a project update: arctic invertebrate zoology; a list of selected acronyms; a list of requests for material or information required for studies of the Canadian fauna 1996, and many other news and general interest items.

Copies of the newsletter can be obtained from:

H. V. DANKS

Head, Biological Survey of Canada (Terrestrial Arthropods), Canadian Museum of Nature, P.O. Box 3443, Station D, Ottawa, Ontario, Canada K1P 6P4

## *The Boreal Dip Net*

Volume 1, Number 1, Winter-Spring 1996: the new Newsletter of the Working Group on Amphibian and Reptile Conservation in Canada was mailed out in March. The "Working Group" is an expansion of the IUCN/SSC Task Force on Declining Amphibian Populations in Canada (DAPCAN) in order to include the study of reptiles as well as amphibians. DAPCAN becomes a subgroup of the new "Working Group". Previously the Canadian Association of Herpetologists (CAH) has included DAPCAN activities in their newsletter which became, informally, the publication of DAPCAN. The new newsletter is an independent venture.

The first meeting of the new Working Group on Amphibian and Reptile Conservation in Canada will be held on 5-7 October 1996 in conjunction with the IUCN/SSC Task Force on Declining Amphibians in Canada at the University of Calgary, Alberta. The program will include a symposium on the Conservation of Reptile Populations in Canada and a workshop on Herpetological Atlasing. For more information contact:

STAN A. ORCHARD

*Chairman and DAPCAN National Co-ordinator*, 1745 Bank Street, Victoria, British Columbia, Canada V8R 4V7 *Phone/Fax 604-595-7556 * E-mail: sorchard@islandnet.com

CAROLYN SEBURN

*Vice-chairman and DAPCAN Co-ordinator for Eastern Canada*, 930 River Road, RR#4, Kemptville, Ontario, Canada K0G 1J0 * Phone/Fax 613-258-6142 * E-mail: aw964@freenet.carleton.ca

ANDREW DIDIUK

*Vice-chairman and DAPCAN Co-ordinator for Western Canada*, Saskatchewan Monitoring Project and Saskatchewan Herpetology Atlas Project, 314 Egbert Avenue, Saskatoon, Saskatchewan, Canada S7N 1X1 * Phone 306-975-4087 * Fax 306-975-4089 * E-mail: didiuka@desoto.wxe.sk.doe.ca

## *The Ontario Chorus*

Volume 1, Number 2, February 1996, the second issue of a newsletter for participants in volunteer amphibian monitoring programs in Ontario, has been distributed by Environment Canada. The intent of this publication is to report highlights of the various monitoring programs and focus on issues of concern to Ontario herpetologists, environmentalists and program volunteers. This issue features articles titled "Volunteer Amphibian Monitoring Programs Gain Momentum", "Volunteering in Great Lakes Marshes", "Ontario Hosts Amphibian Population Conferences" and "The Appreciation Corner", the last listing participants in 1995 of two programs: "Road Call Counts" and "Backyard Surveys".

CANADIAN WILDLIFE SERVICE

Canada Centre for Inland Waters, P.O. Box 5050, 867 Lakeshore Road, Burlington, Ontario, Canada L7R 4A6

## Missouri Botanical Garden 1996 Update

The 1996 AABGA Annual Conference "Roots in the Past, Routes to the Future" will be hosted 30 May - 1 June. A major question to be addressed is the readiness for the Information Highway, the Internet and Virtual Gardening.

Ground will be broken this spring for the Gardens's $19.4 million research center, to be constructed with special "base isolator" technology to prevent earthquake damage. This building will house the herbarium and library, provide adequate working space for researchers, and serve as a major international resource of scientific information for corporate, government and university researchers working in biotechnology and related fields.

A new Applied Research Department will be headed by Dr. James Miller, formerly assistant head of the Madagascar Department. The new department's activities will include "bioprospecting" projects for the U.S. National Cancer Institute and Monsanto Corporation, providing both organizations with plant samples for testing for medical, anti-fungal, and anti-insect properties. Another program is the creation of a bank of plant samples for DNA extraction. An index will be available on the Internet to encourage use of the bank by molecular researchers.

*The Flora of Venezuelan Guayana*, the initial two volumes of a projected 11, was co-published with the Timber Press, Inc. in late 1995.

*The Flora of North America*, will be supported by an continuing grant awarded by the National Science Foundation of nearly $1 million over the next 3 years. When complete it will include 14 printed volumes, a CD-ROM, a new regional database, and a variety of information on Internet, including a full-feature WWW site and easy access to the *Flora* database.

*The Flora of Chile* was published in August 1995 by the University of Conception Press in Conception, Chile, in collaboration with international coordinators which included the Missouri Botanical Garden.

The Garden library collections have been computerized and are available through Internet. Included are the general collection of 110 000 volumes of monographs and journals, and specialized collections of rare books, manuscripts, historical documents, and personal papers. Instruction for accessing the catalog is available by E-mail to molib@mobot.org.

The Garden Herbarium now includes more than 4.5 million specimens of mosses, ferns, gymnosperms, and flowering plants. Each specimen is being bar coded for ease of tracking loans, etc.

The Garden's database, TROPICOS, now contains more than 740 434 of the million published plant names, and information on more than 180 830 type specimens, more than 673 770 distribution records, nearly 347 187 synonyms, literature reports on chromosome counts, and ways in which plants have been used by, or had an effect on, humans.

The Missouri Botanical Garden has a WWW Home Page at http://www.mobot.org. A special "news" section is going up soon.

DELLE WILLETT

*Public Relations*, Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299 *Phone 314-777-5100

## *Global Biodiversity*

Volume 5, Number 4, Spring 1996, contains 48 pages and includes papers on "Cop-1: The NGO perspective" by Elizabeth May; "Deforestation - out of control in Venezuela" by Julio Cesar Centeno; "The re-emergence of fibre hemp in Canada by Sean Twomey; "Linking gastronomic sin and environmental virtue: Growing bananas and chocolate organically in Costa Rica" by William O. McLarney; "Spanish national inventory on road mortality of vertebrates" by Javier Caletrio, Jose Maria Fernandez, Javier Lopez, and Federico Roviralta. "A portrait of biodiversty" pictures a wasp of the genus *Evania* with a text of fact on the relevance and diversity of its group. A Views section features "Evangelicals urge [U.S.] Congress to strengthen the *Endangered Species Act*". A Biotech Corner contains "Indigenous person from Papua New Guinea claimed in U.S. government patent" by Pat Mooney, and "Bioprospecting or biopiracy?" by Linda C. Nowlan. Other sections cover News (Biodiversity news, Cyberdiversity, and Biodiversity meetings), Reviews (both books and periodicals) and *The Last Word*, a message corner from the President of the Canadian Museum of Nature* "Sustainable yield: Is it possible?" This is the only feature to include a picture of the author.

Price of copies and subscriptions may be obtained from: Dawn Arnold, *Business Manager* (613-993-5908), or Susan Swan, *Subscription Manager* (623-990-6671), CANADIAN MUSEUM of NATURE, P. O. Box 3443, Ottawa, Ontario K1P 6P4 *FAX 613-990-0318 *e-mail <darnold@mus.nature.ca>

*Subsequently retired. *The Ottawa Citizen* 8 June 1996, p. A4, "Museum head leaves post."

## Canadian Species at Risk 3 April 1996

The Committee on the Status of Endangered Wildlife in Canada has released *Canadian Species at Risk: April 1996* a 20-page listing of animals and plants designated by the Committee up to and including its most recent Annnal Meeting in April 1996.

In is divided into three parts (1) contains species in the Extinct, Extripated, Endangered, Threatened, and Vulnerable categories: (2) contains species examined and designated in the Not At Risk category and (3) Species examined and designated in the Indeterminate category because of insufficient scientific information. Also included is a record of status reexaminations.

Copies can be obtained from:

SYLVIA NORMAND

Committee on the Status of Endangered Widlife in Canada, Ottawa, Ontario K1A 0H3 * Phone: (819) 997-4991

## Amphipacifica: Journal of Systematic Zoology

Volume II, Number 2 is dated 10 April 1966 and contains an Editorial and two feature articles "The Amphipod Superfamily Hadzioidea on the Pacific Coast of North America: Family Melitidae. Part I. The *Melita* Group: "Systematics and Distributional Ecology" by Norma E. Jarrett and E. L. Bousfield, pages 3–74; and "The Amphipod Family Oedicerotidae on the Pacific Coast of North America. Part I. The *Monoculodes* and *Synchelidium* Generic Complexes: "Systematics and Distributional Ecology" by E. L. Bousfield and Andrée Chevrier, pages 75–148.

E.L. BOUSFIELD

611-548 Dallas Road, Victoria, British Columbia Canada V8V 1B3

## Editor's Report for *The Canadian Field-Naturalis*t Volume 109 (1995)

Ninety-five research, observation, synthesis, or tribute manuscripts were submitted to *The Canadian Field-Naturalist* in 1995. By the calender year's end, evaluations by associate editors and additional reviewers were complete for all but 24. Of those returned to authors, 44 were subsequently accepted after requested revisions had been made; 24 of these were published in volume 108, the remaining 20 were with the printer for 110(1) and (2).

The journal continues to have a healthy and broad circulation. The totals for *The Canadian Field-Naturalist* individual and institutional subscribers for 1995 are given in Table 1. A geographic tabulation of members of The Ottawa Field-Naturalists' Club in 1995 is given in the Membership Committee section of the Report to Council, page 368 in this issue. The total circulation in 1995 (subscribers and memberships combined) was 1811 copies per issue. With its generalized content in research and observation articles and notes, very strong Book Review section, frequent tributes, news and comment items, and occasional historical and survey contributions, *The Canadian Field-Naturalist* contributes to the knowledge of the natural history of northern North America and relevant adjacent areas supported by a moderate annual membership in The Ottawa Field-Naturalists' Club or non-member subscription to *The Canadian Field-Naturalist*. In addition, authors and their institutions generally share in the cost of publication through page, table, figure and reprint charges. (In general, membership [about 40% of dues] contribution and subscriptions [the full amount] account for approximately half the costs of publication, charges make up the balance).

Issue mailing dates for volume 109 were: (1) 21 July, (2) 12 October 1995, (3) 9 January 1996, and (4) 22 February 1996. The time from receipt to return for revision, and from acceptance to publication was reduced during the year. (Receipt and acceptance dates are given at the end of each article and note in each issue), and the number of submissions rose slightly. The volume totalled 542 pages, the largest single issue (4) was 152 pages. Major contributions in this volume were a catalogue of freshwater algae in Quebec by Michael Poulin, Paul B. Hamilton, and Marc Proulx in 109(1): 27-110, for which the Canadian Museum of Nature contributed substantially to page costs. Additionally, 109(3) was devoted to the three-section history of exploration of the vascular flora of Canada, St. Pierre et Miquelon, and Greenland by James S. Pringle, with publication made possible by the cosponsorship of the Missouri Botanical Garden, St. Louis, Missouri.

The number of articles and notes is summarized in Table 2 by topic, the totals for Book Reviews and New Titles in Table 3, and the distribution of pub-

TABLE 1. Subscriber totals to *The Canadian Field-Naturalist* 1995

| | Canada | USA | Foreign | Total |
|---|---|---|---|---|
| Individuals | 170 | 61 | 8 | 239 |
| Institutions | 206 | 266 | 46 | 518 |
| Totals | 376 | 327 | 54 | 757 |

Note: See Annual Report, Membership, for 1995 totals for membership in The Ottawa Field-Naturalists' Club, page 368, which are additional to the subscriber totals given here.

TABLE 3. Number of reviews and new titles published in Book Review section of *The Canadian Field-Naturalist* Volume 109 by topic.

| | Reviews | New Titles |
|---|---|---|
| Zoology | 32 | 63 |
| Botany | 8 | 25 |
| Environment | 22 | 52 |
| Miscellaneous | 9 | 8 |
| Young Naturalists | 0 | 38 |
| Totals | 71 | 186 |

lished pages among issues in Table 4. Looking ahead to volume 110, number 1 will be a Special Issue: "A Life with Birds: Percy A. Taverner, Canadian Ornithologist, 1875" a biography by John L. Cranmer-Byng, Professor Emeritus, Department of History, University of Toronto. Taverner was the author of *Birds of Eastern Canada* (1919), *Birds of Western Canada* (1926), and *Birds of Canada* (1934) all published by the National Museum of Canada and all standard references of their time. I am particularly grateful to Henri Ouellet, W. Earl Godfrey, Ross James, and Daniel Brunton for their discussions and recommendations on this manuscript, to Ross for the initial suggestion that we consider publishing it, and to John and Margaret Cranmer-Byng for coming to Ottawa for two delightfully productive editorial conferences on the manuscript and their subsequent response to all editorial questions and suggestions. Arch Stewart and Mireille Boudreau, Library, Canadian Museum of Nature, provided bibliographic help and Bonnie Livingstone, Publications section, Canadian Museum of Nature, arranged approvals for the Museum photo in 109(3) and the majority in the Taverner issue to be published in 1996. Thanks are also due the journals *Amphipacifica* and *Global Biodiversity* for running notices on The Ottawa Field-Naturalist's Club's contributions to the biodiversity publication through *The Canadian Field-Naturalist* and its predecessors since 1880 (*Transactions* to 1887, replaced by *The Ottawa Naturalist* to 1919).

M.O.M. Printers, Ottawa, set and printed the journal and special thanks are due Emile Holst and Eddie Finnigan and their staff. Wanda J. Cook proof-read the galleys for the volume. Mickey Narraway remained on standby call for any additional assistance to the Editor. Regretfully, she has elected to step down from this role in 1996. Bill Cody continued as Business Manager, assisted by Lois Cody. Lois will be relinquishing her position as assistant to the Business Manager in 1996, after decades of formal and informal contributions in this role, and her contribution and dedication will be hard to duplicate. Bill oversaw the compilation, and proof-read and edited, the Index for volume 109 which was diligently prepared by Leslie Cody, who on her marriage this year elected to change her name to Durocher. Wilson Eedy continued his fine contribution as Book Review Editor including the compilation of New Titles despite increasing world travel on other duties during the year.

Other strengths in the journal are the Associate Editors who review manuscripts in their particular

TABLE 2. Number of articles and notes published in *The Canadian Field-Naturalist* Volume 109 (1995) by major field of study.

| Subject | Articles | Notes | Total |
|---|---|---|---|
| Mammals | 8 | 12 | 20 |
| Birds | 8 | 10 | 18 |
| Amphibians and reptiles | 2 | 3 | 5 |
| Fish | 1 | 1 | 2 |
| Invertebrates | 1 | 1 | 2 |
| Plants | 9 | 4 | 13 |
| Other | 1* | 0 | 1* |
| Totals | 30* | 31 | 61* |

*a Tribute to Henry Mousley in News and Comment in 109(2).

TABLE 4. Number of pages published in *The Canadian Field-Naturalist* Volume 109 (1995) by section (number of manuscripts in parenthesis).

| Issue number: | - 1 - | - 2 - | - 3 - | - 4 - | Total |
|---|---|---|---|---|---|
| Articles | 110 (6) | 108(12) | 87 (3) | 50 (8) | 355 (29) |
| Notes | 12 (6) | 15 (8) | 0 (0) | 39 (17) | 66 (31) |
| News and Comment | 9 (12) | 16 (8) | 4 (3) | 2 (4) | 31 (27) |
| Book Reviews* | 11 (17) | 8 (7) | 4 (2) | 39 (45) | 62 (71) |
| Index | — | — | 5 (1) | 20 (1) | 25 (2) |
| Advice to Contributors | 0 (0) | 1 (1) | 0 (0) | 1 (1) | 2 (2) |
| Next issue notice | — | — | — | 1 (1) | 1 (1) |
| Total pages: | 142 | 148 | 100 | 152 | 542 |

*Total pages for Book Review section include both reviews and new titles listings but parenthesis figures include only the number of reviews.

field and often provide recommendations of additional reviewers. Robert Anderson (Research Division, Canadian Museum of Nature, Ottawa), Warren Ballard (Wildlife Research Unit, Faculty of Forestry Research, University of New Brunswick, Fredericton, New Brunswick), Charles D. Bird (Erskine, Alberta), Robert R. Campbell (Woodlawn, Ontario), Brian W. Coad (Research Division, Canadian Museum of Nature, Ottawa), Anthony J. Erskine (Canadian Wildlife Service, Sackville, New Brunswick), W. Earl Godfrey (Curator Emeritus, Canadian Museum of Nature), Diana Laubitz (Researcher Emeritus, Canadian Museum of Nature), and William O. Pruitt, Jr. (Department of Zoology, University of Manitoba, Winnipeg) continued to serve as Associate Editors in 1995. George La Roi (University of Alberta, Edmonton, Alberta) continued as Coordinator of the Biological Flora of Canada series. At the end of the year, Diana Laubitz was determined to relinquish her contribution as an Associate Editor to coincide with winding up her research projects at the Museum. Her evaluations and encouragement will be greatly missed. I am indebted to her both for thoughtful and incisive advice and counselling over the six years she has served as an Associate Editor for invertebrates (exclusive of insects), and for the many more years she has been my colleague both as an active member of the Ottawa Field-Naturalists' Club and as a staff member at the National Museum of Canada/ Canadian Museum of Nature.

Supplementing the views of Associate Editors, the following kindly returned reviews on request for one or more manuscripts in 1995: Stewart Alexander (Whitehorse, Yukon), R. C. Anderson (University of Guelph, Guelph, Ontario), Brad Andres (U. S. Fish and Wildlife Service, Anchorage, Alaska), C. Davison Ankney (University of Western Ontario, London, Ontario), George W. Argus (Canadian Museum of Nature, Ottawa, Ontario), J. Roger Bider (MacDonald Campus of McGill University, Ste Anne de Bellevue, Quebec), David M. Bird (MacDonald Campus of McGill University, Ste. Anne de Bellevue, Quebec), David A. Boag (Brentwood Bay, British Columbia), Stan Boutin (University of Alberta, Edmonton, Alberta), Ronald J. Brooks (University of Guelph, Guelph, Ontario), Luc Brouillet (Institut de recherche en biologie végétale, Montréal, Québec), Daniel F. Brunton (Ottawa, Ontario), Robert Elner (Canadian Wildlife Service, New Westminster, British Columbia), Mike Cadman (Canadian Wildlife Service, Guelph, Ontario), Ludwig Carbyn (Canadian Wildlife Service, Edmonton, Alberta), Paul M. Catling (Agriculture Canada, Ottawa, Ontario), Jacques Cayouette (Agriculture Canada, Ottawa, Ontario), François Chapleau (University of Ottawa, Ottawa, Ontario), Jerry G. Chmielewski (Slippery Rock University, Slippery Rock, Pennsylvania), William J. Crins (Ontario Ministry of Natural Resources, Huntsville, Ontario), Peter Ross Croskery (Grimsby, Ontario), E. J. Crossman (Royal Ontario Museum, Toronto, Ontario), Ron Cumberland (Department of Natural Resources and Energy, Fish and Wildlife Branch, Fredericton, New Brunswick), Stephen Darbyshire (Agriculture Canada, Ottawa, Ontario), Terry A. Dick (University of Manitoba, Winnipeg, Manitoba), Kathyrn Dickson (Canadian Wildlife Service, Hull, Quebec), T. G. Dilworth (University of New Brunswick, Fredericton, New Brunswick), Michael G. Dolinski (Alberta Agriculture, Food and Rural Development, Edmonton, Alberta), George W. Douglas (British Columbia Conservation Data Centre, Victoria, British Columbia), David Duncan (Saskatchewan Wetland Conservation Corporation, Regina, Saskatchewan), Patricia A. Duncan and James R. Duncan (Carven, Saskatchewan), Erica Dunn (Canadian Wildlife Service, Ottawa, Ontario), Leonard J. Easton (Nova Scotia Agriculture College, Truro, Nova Scotia), Carl H. Ernst (George Mason University, Fairfax, Virginia), M. Brock Fenton (York University, North York, Ontario), Graham Forbes (University of New Brunswick, Fredericton, New Brunswick), Bill Freedman (Dalhousie University, Halifax, Nova Scotia), John Fryxell (University of Guelph, Guelph, Ontario), Daniel Gagnon (Université du Québec a Montréal et Biodome de Montréal, Montréal, Québec), Cheri Gratto-Trevor (Canadian Wildlife Service, Saskatoon, Saskatchewan), Patrick T. Gregory (University of Victoria, Victoria, British Columbia), Erich Haber (National Botanical Services, Ottawa, Ontario), Fred Harrington (Mount St. Vincent University, Halifax, Nova Scotia), Vernon L. Harms (University of Saskatchewan, Saskatoon, Saskatchewan), Ken Harris (Ontario Ministry of Natural Resources, Carleton Place, Ontario), Stuart Hay (Université de Montréal, Montréal, Québec), David Henry (Canadian Heritage Directorate - General Prairie and Northern Region, Winnipeg, Manitoba), Thomas Herman (Acadia University, Wolfville, Nova Scotia), Erling Holm (Royal Ontario Museum, Toronto, Ontario), Eli Holmes (University of Washington, Seattle, Washington), Stuart Houston (Saskatoon, Saskatchewan), Ross James (Royal Ontario Museum, Toronto, Ontario), Stephen R. Johnson (LGL Limited Environmental Research Associates, Sidney, British Columbia), Daniel M. Keppie (University of New Brunswick, Fredericton, New Brunswick), Brina Kessel (University of Alaska-Fairbanks Museum, Fairbanks, Alaska), Michael Kingsley (Institut Maurice La Montagne, Mont-Joli, Québec), Gordon L. Kirkland, Jr. (Shippenburg University, Shippenburg, Pennsylvania), Richard W. Knapton (Long Point Bird Observatory, Port Rowan, Ontario), M. Steve Lapan (Bureau of Fisheries, Waterton, New York), J. Donald Lafontaine

(Agriculture Canada, Ottawa, Ontario), Raymond LeClair (Université de Trois Rivières, Trois Rivières, Quebec), Richard D. Leonard (Winnipeg, Manitoba), Frederick G. Lindzey (Wyoming Cooperative Fish and Wildlife Research Unit, Laramie, Wyoming), Ross D. MacCulloch, (Royal Ontario Museum, Toronto, Ontario), W. Bruce McGillivray (Provincial Museum of Alberta, Edmonton, Alberta), B. MacKinnon, (University of New Brunswick, Fredericton, New Brunswick), Douglas B. McNair (Buckingham, North Carolina), Frank F. Mallory (Laurentian University, Sudbury, Ontario), Martin K. McNicholl (Burnaby, British Columbia), Mary Meagher (National Biological Survey, Yellowstone National Park, Wyoming), L. David Mech (US Fish & Wildlife Service, St. Paul, Minnesota), J. K. Morton (University of Waterloo, Waterloo, Ontario), David Nagorsen (Royal British Columbia Museum, Victoria, British Columbia), Robert W. Nero (Manitoba Natural Resources, Winnipeg, Manitoba), Thomas W. Nudds (University of Guelph, Guelph, Ontario), Henri Ouellet (Canadian Museum of Nature, Ottawa, Ontario), Gerry Parker (Canadian Wildlife Service, Sackville, New Brunswick), Alex Peden (Royal British Columbia Museum, Victoria, British Columbia), Michel Poulin (Canadian Museum of Nature, Ottawa, Ontario), Gilbert Proulx (Alpha Wildlife and Management Limited, Sherwood Park, Alberta), Scott Redhead (Agriculture Canada, Ottawa, Ontario), Austin Reed (Canadian Wildlife Service, Ste. Foy, Quebec), Randall Reeves (Okapi Wildlife Associates, Hudson, Quebec), James D. Rising (University of Toronto, Toronto, Ontario), Frederick W. Schueler (Bishops Mills, Ontario), J. C. Semple (University of Waterloo, Waterloo, Ontario), Doug Skinner (D. A. Westworth and Associates Ltd., Edmonton, Alberta), Kenneth W. Stewart (University of Manitoba, Winnipeg, Manitoba), Rudolph F. Stocek (Maritime Forest Ranger School, Fredericton, New Brunswick), Mike Sullivan (Department of Natural Resources and Energy, Fish and Wildlife Branch, Fredericton, New Brunswick), Tom Sullivan (University of British Columbia, Vancouver, British Columbia), Edmund S. Telfer (Canadian Wildlife Service, Edmonton, Alberta), Shaun Thompson (Ontario Ministry of Natural Resources, Kemptville, Ontario), Michelle Wheatley (Kilpisjarven biologinen asema, Finland), Robert E. Wrigley (Winnipeg, Manitoba), Heather Whitlaw (University of New Brunswick, Fredericton, New Brunswick), Stan Van Zyll de Jong (North Augusta, Ontario), Dennis Voigt (Ontario Ministry of Natural Resources, Maple, Ontario), D. E. Yarborough (University of Maine, Orono, Maine). [In the list of reviewers in the Editors Report for volume 108 (1994) in *The Canadian Field-Naturalist* 109(2): 269-271, Graham Forbes, University of New Brunswick, Fredericton, New Brunswick, was omitted and Heather Whitlow's surname was misspelled "Whitler". My apologies to both]

I am also indebted to Frank Pope, President of the Ottawa Field-Naturalists' Club, the Club Council, Chairman Ron Bedford and the Publications Committee of the OFNC for their support, to The Canadian Museum of Nature for allowing me to continue to use some space and facilities at the Macoun Nature Centre at Aylmer, and to Joyce for encouragement at home, where most of the editing is done, throughout the year.

FRANCIS R. COOK
*Editor*

# Minutes of the 117th Annual Business Meeting of The Ottawa Field-Naturalists' Club, 9 January 1996

| | |
|---|---|
| Place and Time: | Community Gallery, Canadian Museum of Nature, Metcalfe and McLeod Streets, Ottawa, 19:30 h |
| Chairperson: | Frank Pope, President |
| Attendance: | Thirty-one persons attended the meeting. |

Frank Pope opened the meeting by asking members to spend the first half hour reviewing copies of the minutes of the previous meeting, a proposed amendment to Article 17 of the Constitution, the Treasurer's Report, and the reports of Committees.

1. **Minutes of the Previous Meeting**

No errors or omissions were identified. It was moved by Dave Moore (2nd Fenja Brodo) that the minutes be accepted.

(Motion Carried)

2. **Business Arising from the Minutes**

There was no business arising from the minutes.

3. **Proposal to Amend Article 17 of the Constitution**

Frank Pope introduced a proposal to amend Article 17 of the Constitution which had been published previously in Volume 108, Number 3, of THE CANADIAN FIELD-NATURALIST. When the present wording of Article 17 was approved at the 114th Annual Business Meeting it was criticized for permitting a major revision to the Constitution in one block. The intent of the proposed amendment was to resolve that problem by permitting more than one change at a time only when those changes are "editorial and do not alter the intent of any article". Under any other circumstances, changes to the Constitution must be introduced and approved individually. The meeting approved the proposal.

(Motion Carried)

4. **Treasurer's Report**

Gillian Marston opened her remarks by noting the favourable report from the Club's Auditor. In reviewing details of the financial statements, she noted an increase in Member's Equity from \$216 097 to \$233 483 and an increase in the de Kiriline-Lawrence Fund from \$10 478 to \$12 749. There was a significant increase in the cost of publishing THE CANADIAN FIELD-NATURALIST, as a result of an increase in the cost of paper.

It was moved by Gillian Marston (2nd Ken Young) that the Treasurer's report be accepted.

(Motion Carried)

5. **Committee Reports**

Frank Pope introduced each of the Committee reports and asked for comments and questions. Several members asked for clarification of some points. In response to a question regarding the report of the Executive Committee, Frank said that an ad hoc committee had been established to review the use of the Member's Equity in meeting the objectives of the Club, and it had made three recommendations to the Council; a) set aside money for the special publications recommended by the Publications Committee, b) support land acquisition by organizations such as the Nature Conservancy of Canada, c) assist environmental educators in the Ottawa region. The Council is still considering these recommendations.

It was moved by Fenja Brodo (2nd Gillian Marston) that the Committee reports be accepted.

(Motion Carried)

6. **Nomination of the Auditor**

It was moved by Ken Young (2nd Gillian Marston) that Janet Gehr continue as Auditor for another year.

(Motion Carried)

7. **Report of the Nominating Committee**

On behalf of the Nominating Committee, Barbara Campbell presented the following slate of candidates for the 1996 Council. New members are indicated with an asterisk:

| | |
|---|---|
| President | Dave Moore |
| Vice-President | Michael Murphy |
| Recording Secretary | Dave Smythe |
| Corresponding Secretary | Eileen Evans |
| Treasurer | Gillian Marston |
| Other Council Members | Ron Bedford |
| | Jeff Harrison |
| | Fenja Brodo |
| | Cendrine Huemer |
| | Lee Cairnie |
| | Ann MacKenzie |
| | Bill Cody |
| | Patricia Narraway |
| | Francis Cook |
| | Frank Pope |

Ellaine Dickson
Tom Reeve*
Colin Gaskell
Jane Topping
Alan German*
Chris Traynor*
Christine Hanrahan
Ken Young

One member of the 1995 Council, Carol German, chose not to stand for re-election, and one member, Trix Geary, resigned during the term of the council.

It was moved by Barbara Campbell (2nd Peter Hall) that the proposed slate be accepted.

(Motion Carried)

8. **New Business**

Frank Pope thanked Lois Cody for her long and valuable contribution to the Club as the Treasurer's Assistant, and in particular her willingness to continue temporarily after her official retirement in September, to ensure a smooth transition to a computer based accounting system.

Frank reviewed the long and fruitful association between the Club and the Canadian Museum of Nature, and the awkward situation in which the Club found itself when it criticized the decision by the Museum to build on a wetland site in Aylmer. In the subsequent discussion of the Museum's action and the Club's response, several members expressed strong disagreement with the Museum's action.

It was moved by Ian Whyte (2nd Fenja Brodo) that the minutes record the fact that the meeting expressed strong disagreement with the Museum's choice of building site in Aylmer.

(Motion Carried)

In his remarks as outgoing President, Frank said that he was proud to have played a part in the history the Club. He thanked The Canadian Museum of Nature, and Agriculture and Food Canada for the use of their facilities, and members of Council and of the Club for their support and encouragement during his four years as President.

9. **Presentation by the Fletcher Wildlife Garden Committee**

Jeff Harrison and Peter Hall gave a presentation on the history and development of the Fletcher Wildlife Garden with before and after slides to show the changes that have taken place. Thousands of hours of volunteer effort are now producing rewards in the form of habitat growth, visitors to the site, and an Interpretive Centre that will enable many more activities at the Garden. For the future, the Garden will remain a volunteer organization and more effort will be made to raise operating and capital funds to ensure that it is self-sufficient.

10. **Adjournment**

At 22:05 h, it was moved by Lee Cairnie (2nd Ian Whyte) that the meeting be adjourned.

(Motion Carried)

DAVE SMYTHE
Recording Secretary

# Committee Reports for 1995 to The Ottawa Field-Naturalists' Club

## Awards Committee

The Following awards were presented at the annual Soiree held on April 28, 1995:

1994 – MEMBER OF THE YEAR AWARD: Tony Beck for his enthusiastic involvement in the OFNC seedathon, Bird Records Sub-committee, Chairmanship of the Birds Committee, and for his continuing service on bird walks and coordinated field trips.

1994 – GEORGE MCGEE SERVICE AWARD: Ron Bedford for his 14 years of service as Chairman of the Publications Committee, for his longtime record of service on OFNC Council, and his participation on field trips.

1994 – CONSERVATION AWARD (OFNC MEMBER): Ian Huggett a second Conservation Award, for his continuous commitment to conservation in the National Capital Region and for his leadership in mobilizing of the citizens of Aylmer Quebec, to protect the Wychwood pine forest.

1994 – CONSERVATION AWARD (NON–MEMBERS): The Goulbourn Environmental Advisory Committee for the conversion of the abandoned Richmond sewage lagoons into a wetland conservation area, thereby establishing new freshwater marsh habitats for resident water birds and providing educational opportunities for local residents and naturalists.

Because the Club has maintained its full complement of twenty-five Honorary Members, there were no Honorary Memberships confirmed this year. Also, there was no recommendation for the Anne Hanes Natural History Award.

BILL ARTHURS

## Birds Committee

A plan of action for the reactivation of the Bird Records Sub-Committee in early 1996 was developed.

The Committee oversaw the Late Fall Count. The turnout was much improved over 1994 perhaps due to the change back to a single day event. The Committee also oversaw the Ottawa-Hull Christmas Bird Count, and officially accepted responsibility for the Dunrobin-Breckenridge Christmas Bird Count from Bruce Di Labio who will continue to oversee it.

The Committee tended the Bird Status Line. A new permanent number (860-9000) was installed in downtown Ottawa to minimize long distance charges for birders in outlying areas. The Rare Bird Alert was updated to reflect the changing composition of the birding community.

The archiving of materials from the Committee's activities is nearly complete, including nearly 200 slides of rare birds. The Committee took care of the Club feeders and raised over $1000 from the Seedathon for their maintenance. Arrangements were made to have the American Birding Association include the OFNC checklists in its sales catalogue.

TONY BECK

## Computer Management Committee

The Computer Management Committee ensures the efficient and controlled use of the computer assets of the Club. It maintains and improves existing systems and increases awareness of how computer facilities may be of benefit to other committees.

This year, members of the Committee assisted in the selection of a computer system for the Treasurer's Assistant and the replacement of the computer used by the Membership Committee. They also provided various support services to the users of the computer system used to publish Trail & Landscape.

MICHAEL MURPHY

## Conservation Committee

The Committee liaised with local Conservation Authorities and Provincial Ministries concerning various programs including the Landowner Resources Centre, the Forest Diversity Project and watershed studies of the Jock River.

Members of the Committee participated in the Marlborough Forest Advisory Committee of the Regional Municipality of Ottawa-Carleton (RMOC) and reviewed environmental policies in the RMOC official plan. The Wetlands Working Group, of which OFNC is a member, submitted recommendations to the RMOC Council in an attempt to reconcile naturalist and landowner conflicts with regard to the Ontario Wetlands Policy (1992) as it is to be applied in Ottawa-Carleton.

The Committee made various submissions to the RMOC, the National Capital Commission (NCC), and the Ontario Municipal Board to advocate the protection and enhancement of natural areas in Ottawa-Hull. These included submissions on a proposed subdivision in the Leitrim Wetland (Gloucester), the "outsourcing" of park management by the NCC (Gatineau Park), the Canadian Museum of Nature Consolidation Project (Aylmer), the Kanata North Expansion proposal (Kanata), the Transportation Master Plan (RMOC) and the Natural Environmental Study (RMOC).

MICHAEL MURPHY

## Education & Publicity Committee

With the help of approximately 45 volunteers, the Committee set up the Club's display at four different locations. The Committee responded to nine requests for speakers and seven requests for walk leaders from various Church groups, Seniors homes, scouting groups and others.

Posters were designed and posted to advertise monthly meetings of the Club. Judges and prizes were arranged for the Ottawa Science Fair. New slide presentations were provided during the year, and work continues on a new set of slides.

The FreeNet connection was refined and a plan for expansion was started. Work continues on a telephone list of environmental and other agencies for the use of members.

DAVE MOORE

## Excursions & Lectures Committee

During the past year, a varied program of 46 same-day outdoor activities was scheduled for Club members, four of which required the use of a chartered bus. An indoor workshop on bird identification by sight and sound was an additional event. Approximately 80% of all outings were conducted within the Ottawa district. A weekend outing to Algonquin Park and a four-day excursion to Point Pelee were also arranged.

Traditional OFNC social functions such as the Annual Soiree, Members' Slide Night, and the Annual Picnic once again proved to be successful ventures. The Committee supported a motion to Council by the Membership Committee to discontinue the New Members Night in response to dwindling attendance over the past two years.

A series of eight evening lectures featuring a stimulating mix of speakers, was well attended.

COLIN GASKELL

## Executive Committee

On February 1st, the Committee met to discuss the issues anticipated in the coming year. It decided to continue the current format of the Annual Business Meeting. It decided to continue holding the monthly

meetings at the Canadian Museum of Nature notwithstanding the Museum's new policy of charging for the use of rooms, and concern was expressed about the site in Aylmer chosen by the Museum for its new facility. The Club's relationship with the Federation of Ontario Naturalists and the Canadian Nature Federation was discussed. The healthy financial reserves of the Club, led to a decision to set up an ad hoc committee to investigate possible uses of some of these funds to further the objectives of the Club.

On June 29th, the Committee met to discuss transferring the Club's financial accounts from a manual system to a computer system and to fill a future vacancy in the position of Treasurer's Assistant. It was decided to establish a committee to implement the transition.

FRANK POPE

### Finance Committee

The Committee considered the recruitment of an assistant for the Treasurer to replace Lois Cody who retired at the end of the fiscal year, and the replacement of the current ledger based accounting system with one based on a software package.

KEN YOUNG

### Fletcher Wildlife Garden Committee

For the past two years the project has been slowed awaiting transfer of responsibility for Building 138 (the interpretive centre) from Agriculture Canada. With the project in jeopardy due to lack of a facility, it was decided to "occupy" the building with Agriculture Canada's unofficial approval.

Between February and April approximately 50 volunteers in many working bees, cleaned and painted the Centre. A workshop for tour leaders was conducted. The public opening on Earth Day April 22nd attracted 200 people and subsequent open houses and tours during the Summer and Fall attracted an additional 300 people.

Tables and chairs were purchased for the Centre and after April, all Garden Committee meetings were held there. The Council met there in June and September.

A donation box designed to look like a Great Blue Heron was built and placed in the Centre attracting donations of about $100. Twenty four t-shirts with the Garden logo were made and given to key volunteers, stakeholders, and members of the media. Two sponsors donated $4500 without solicitation.

In September and October, painting was completed, a septic line was installed, interior plumbing replaced, and storm windows were fixed and installed, at a total cost of about $10,000.

In the model backyard garden, some perennials were added, and a cedar hedge was planted. A troop from Scouts Canada adopted the new woods and planted 500 trees in May. In the old woodlot, more woodland plants were brought in.

The self-guided trail brochure was reprinted including a french edition. A dispensing box was affixed to the door so that visitors can take a brochure and tour the site when the Centre is closed. Over the year, volunteers contributed approximately 1000 hours of time.

JEFF HARRISON

### Macoun Field Club Committee

The Committee met six times during the year to plan the weekly schedule for the children and young people of the Club. Field trips and camping trips were balanced with indoor presentations by members of the local naturalist and scientific community. A gift from the Excursions & Lectures Committee made possible an all-day bus trip to Murphy's Point Provincial Park for the whole Club.

A determined effort was made to welcome a student with a serious hearing impairment into the Club. The willing acquisition of sign language by both other children and the leaders encourages us to think it will be possible to accommodate deaf members in the future.

The Club published the 49th issue (in the Club's 47th year) of the Little Bear, in June, with an important section on members' Study Area projects.

ROBERT LEE

### Membership Committee

The total membership paid up for 1995, was 1054; an increase of 21 from 1994. There were 138 new members, including 80 Individual, 57 Family, and one Sustaining. A detailed breakdown of these numbers with the 1994 numbers in brackets, follows:

Four complimentary one-year memberships were presented to outstanding young participants in the Annual Science Fair.

Mr. Claude E. Garton was added to "Golden Anniversary" membership list. Claude joined the Club in 1945 and was awarded an Honorary membership in 1985.

PATRICIA NARRAWAY

### Publications Committee

The publications Committee oversees and advises on all aspects of the Club's publications. It met three times in 1995.

With the appearance of four issues of *The Canadian Field-Naturalist* (Volume 108, Numbers 3, 4 and Volume 109, Numbers 1, 2) in 1995, and two more ready to go to press, the publication of the Journal is essentially back on schedule. These four issues contained 566 pages, 36 articles, 34 notes, one COSEWIC article, 63 book reviews, 221 new titles, one commemorative tribute, and 18 pages of news and comments. All of the Associate Editors accepted reappointment for 1995. The number of subscriptions to *The Canadian Field-Naturalist* (CFN) remains stable.

| | CANADA | | FOREIGN | | |
|---|---|---|---|---|---|
| Type | Local | Other | USA | Other | Total |
| Family | 355 (335) | 22 (24) | 3 (4) | 0 (0) | 380 (363) |
| Honorary | 14 (14) | 10 (10) | 1 (1) | 0 (0) | 25 (25) |
| Individual | 432 (402) | 135 (144) | 24 (23) | 4 (4) | 595 (573) |
| Life | 15 (15) | 20 (18) | 2 (3) | 2 (2) | 39 (38) |
| Sustaining | 9 (29) | 5 (4) | 1 (1) | 0 (0) | 15 (34) |
| Total | 825 (795) | 192 (200) | 31 (32) | 6 (6) | 1054 (1033) |

Volume 29 of *Trail & Landscape* was published in four issues that contained 172 pages, with again a large emphasis on bird-related articles. Three issues were accompanied by a one-page insert of the Green Line.

During 1995 some special requests were considered. The OFNC applied for, but was unsuccessful in obtaining, a grant from Science Culture Canada towards the publishing of a book for young naturalists by Joe Shepstone. The Club approved a grant of $2000 towards the publication of the Butterflies of Canada by P. Hall, D. Lafontaine, and R. Layberry. *The Canadian Field-Naturalist* also agreed to publish, with the cooperation of the Missouri Botanical Garden, three articles on the history of botanical exploration in Canada, Greenland, and Saint-Pierre and Miquelon. *The Canadian Field-Naturalist* has also arranged to publish a biography of P. A. Taverner, in a future issue.

RONALD BEDFORD

# The Ottawa Field-Naturalists' Club Financial Statements:
**Year ended September 30, 1995**

## Auditor's Report

To: The Members of THE OTTAWA FIELD-NATURALISTS' CLUB:

I have audited the balance sheet of The Ottawa Field-Naturalists' Club as at September 30, 1995, and the statements of operations and members' equity. These financial statements are the responsibility of the organization's management. My responsibility is to express an opinion on these statements based on my audit.

Except as explained in the following paragraph, I conducted my audit in accordance with generally accepted auditing standards. Those standards require that I plan and perform an audit to obtain reasonable assurance whether the financial statements are free of material misstatement. An audit includes examining evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. In common with many non-profit organizations, The Ottawa Field-Naturalists' Club derives some of its revenue from memberships, donations, and fund raising activities. These revenues are not readily susceptible to complete audit verification, and accordingly, my verification was limited to accounting for the amounts reflected in the records of the organization.

In my opinion, except for the effect of the adjustments, if any, which I might have determined to be necessary had I been able to satisfy myself concerning the completeness of the revenues referred to in the preceding paragraph, these financial statements present fairly, in all material respects, the financial position of the OFNC as of September 30, 1995, and the results of its operations for the year then ended in accordance with generally accepted accounting principles.

JANET M. GEHR

Chartered Accountant
North Gower, Ontario 6 January 1996

**The Ottawa Field-Naturalists' Club**
**Balance Sheet**
**September 30, 1995**

| | 1995 | 1994 |
|---|---|---|
| **ASSETS** | | |
| CURRENT ASSETS | | |
| Cash | 270,404 | 260,283 |
| Accounts Receivable | 9,808 | 7,491 |
| Interest Receivable | 4,299 | 3,022 |
| Prepaid Expenses | 1,608 | 1,608 |
| | 286,119 | 272,404 |
| FIXED (Note 3) | – | – |
| LAND - Alfred Bog | 3,348 | 3,348 |
| | 289,467 | 275,752 |
| **LIABILITIES, FUNDS AND MEMBERS' EQUITY** | | |
| CURRENT LIABILITIES | | |
| Accounts Payable | 22,800 | 30,327 |
| Deferred Income | 12,068 | 9,871 |
| | 34,868 | 40,198 |
| FUNDS (Note 4) | 14,616 | 12,957 |
| LIFE MEMBERSHIPS | 6,500 | 6,500 |
| CLUB RESERVES | 100,000 | 100,000 |
| GENERAL EQUITY | 133,483 | 116,097 |
| | 289,467 | 275,752 |

**The Ottawa Field-Naturalists' Club**
**Statement of Members' Equity**
**September 30, 1995**

| | 1995 | 1994 |
|---|---|---|
| EXCESS INCOME (EXPENDITURES) | | |
| The Ottawa Field-Naturalists' Club | 1,476 | 589 |
| Canadian Field-Naturalist | 15,126 | 21,629 |
| | 16,602 | 22,218 |
| OTHER INCOME (ALLOCATIONS) | | |
| Donations - Misc. upon membership renewal | 3,503 | 3,399 |
| Allocation to Kiriline-Lawrence Fund | (2,719) | (1,460) |
| | 784 | 1,939 |
| TOTAL INCOME | 17,386 | 24,157 |
| MEMBERS' EQUITY, Beginning of Year | 216,097 | 191,940 |
| MEMBERS' EQUITY, End of Year | 233,483 | 216,097 |

**The Ottawa Field-Naturalists' Club**
**Statement of Operations - OFNC**
**Year Ended September 30, 1995**

| | 1995 | 1994 |
|---|---|---|
| INCOME | | |
| Memberships | 14,406 | 14,099 |
| T&L Subscriptions and Back Issues | 503 | 645 |
| Interest | 3,212 | 1,864 |
| Other Sales | 2,885 | 1,311 |
| Special Publications | 139 | 149 |
| Total Income | 21,145 | 18,068 |
| EXPENSES | | |
| OPERATIONS EXPENSES | | |
| Affiliation fees | 2,134 | 295 |
| Computer | 3,397 | 3,955 |
| Depreciation | – | 1,255 |
| Membership | 1,702 | 2,564 |
| Office assistant | 748 | 750 |
| Operations | 3,088 | 2,450 |
| OFNC GST Rebate | (499) | (591) |
| Total Operations Expenses | 10,570 | 10,678 |
| CLUB ACTIVITY EXPENSES (Net) | | |
| Awards | – | 8 |
| Soiree | 209 | 356 |
| Birds | – | 334 |
| Conservation | 139 | 184 |
| Education and Publicity | 157 | 403 |
| Excursions and Lectures | (713) | (1,703) |
| Fletcher Wildlife Garden | 1,200 | – |
| Macoun Club | 613 | 1,107 |
| Trail & Landscape | 7,494 | 6,112 |
| Total Club Activity Expenses | 9,099 | 6,801 |
| | 19,669 | 17,479 |
| INCOME OVER EXPENSES | 1,476 | 589 |

**The Ottawa Field-Naturalists' Club**
**Statement of Operations - CFN**
**Year Ended September 30, 1995**

| | 1995 | 1994 |
|---|---|---|
| INCOME | | |
| Memberships | 9,699 | 9,317 |
| Subscriptions | 25,771 | 19,029 |
| Sub-Total | 35,470 | 28,346 |
| Reprints | 6,542 | 8,848 |
| Publication charges | 31,026 | 34,737 |
| Back numbers | 316 | 225 |
| Interest and exchange | 16,485 | 10,339 |
| Total Income | 89,839 | 82,495 |
| EXPENSES | | |
| Publishing | 49,557 | 37,443 |
| Reprints | 6,495 | 5,956 |
| Circulation | 6,743 | 5,369 |
| Editing | 2,475 | 3,707 |
| Office assistant | 4,997 | 4,675 |
| Office supplies | 2,344 | 3,736 |
| Advertising | 145 | 134 |
| Honoraria | 4,500 | 3,000 |
| CFN GST Rebate | (2,543) | (3,154) |
| | 74,713 | 60,866 |
| INCOME OVER EXPENSES | 15,126 | 21,629 |

**The Ottawa Field-Naturalists' Club**
**Notes To The Financial Statements**
**September 30, 1995**

1. *Authority and Activities*

The Ottawa Field-Naturalists' Club is a non-profit organization incorporated under the laws of Ontario (1884). The Ottawa Field-Naturalists' Club promotes the appreciation, preservation and conservation of Canada's natural heritage; encourages investigation and publishes the results of research in all fields of natural history and diffuses information on these fields as widely as possible. It also supports and cooperates with organizations engaged in preserving, maintaining or restoring environments of high quality living things.

2. *Significant Accounting Policies*

Membership, subscriptions and donations are recorded as received. All other revenues and expenditures except for inventory are accounted for on the accrual basis. Memberships are allocated to The Canadian Field-Naturalist publication on a pre-determined percentage.

Supplies, records, tapes and other items held for resale are expensed when purchased.

Fixed assets acquired after 1989 are expensed. Fixed assets acquired prior to 1990 were recorded at cost and depreciated on a straight line basis.

3. *Fixed Assets*

| | 1995 | 1994 |
|---|---|---|
| Cost | 16,746 | 16,746 |
| Accumulated Depreciation | 16,746 | 16,746 |
| Net Book Value | - | - |

4. *Funds*

| | 1995 | 1994 |
|---|---|---|
| Baldwin Memorial Fund | - | 358 |
| Seedathon | 585 | 888 |
| Anne Hanes Memorial Fund | 870 | 815 |
| de Kiriline-Lawrence Fund | 12,749 | 10,478 |
| Alfred Bog | 412 | 418 |
| | 14,616 | 12,957 |

# Book Reviews

ZOOLOGY

## Manual of Ornithology: Avian Structure and Function

By Noble S. Proctor and Patrick J. Lynch. 1993. Yale University Press, New Haven and London. xi + 340 pp., illus. U.S. $40.

This book includes topics expected from this type of work but it is not an introduction to ornithology. Although systematics, topography, and field techniques are discussed and occupy separate chapters, this work is primarily a guide to bird anatomy and function for undergraduate students or graduate students who may not have been acquainted earlier with the structure of birds. Feathers, skeleton, musculature, digestive system, circulatory system, respiratory system, urogenital and endocrine system, and nervous system are the topics of the other chapters. An appendix on bird classification, a bibliography, and an index are also part of the book.

The text is clearly written and abundantly illustrated. The illustrations are accurate and of excellent quality even if some of them are presented in an unusual perspective, at least one that is not found in classical presentations of anatomical topics. Each is accompanied by an extensive caption detailing the contents of the plate and containing a great deal of information about the illustrated topics and instructions on dissection where applicable. Chapter 3, entitled "Topography", will be useful to anyone interested in birds, not only students or ornithologists but also to bird watchers and biologists who need to use ornithological references, because it contains, defines, and illustrates most of the terminology of modern works particularly on external anatomy.

In general the text is complete and up-to-date, the authors having incorporated the most recent information available at publication time. The writing is clear and easy to follow. I found it easy to retrieve information because the layout is clear and well organized, key words being highlighted in bold face characters. The definitions of ornithological terms are precise, succinct, and carefully worded.

Each chapter contains a two-page worksheet of questions where one can verify how much has been retained from reading the previous pages. The worksheets are not unlike those found in Pettingill's *Ornithology in laboratory and field* (1970) but are more detailed and elaborate. There is also a one-page list of references pertaining to the chapter. These references appear also in the main bibliography at the end of the book and although this subject-oriented list of references may appear to be repetitious it helps the reader to find references on a given topic more easily.

Chapter 12, "Field techniques", seems at first to be somewhat out of place in this book but I found its contents useful in presenting various techniques necessary for the study of birds. It should be compulsory reading to all students who plan to undertake studies on birds. Amateurs and bird watchers also will find a wealth of valuable information. The "Classification of Birds" given in appendix is based on the Sibley and Monroe system which has been clearly explained in Chapter 2 (Systematics).

This book will not replace the recent ornithology manuals because of its scope. However, it should be consulted by all students enrolled in an ornithology course. I recommend its reading also to amateurs and bird watchers who will find clear explanations about topics often difficult to access elsewhere in the ornithological literature. This book in spite of its limitations constitutes a complementary reference to other standard ornithology manuals. The quality of the text, illustrations, presentation, and overall production, makes it an essential element in a balanced ornithological library.

HENRI OUELLET

175 avenue de la Citadelle, Hull, Québec J8Z 3L9

## The Downy Waterfowl of North America

By Colleen Helgeson Nelson. 1993. Delta Station Press, Portage la Prairie, Manitoba. xx + 302 pp., illus. $49.95 + $5.00 shipping and handling.

After many years in preparation, this exhaustive work on the downy plumages of North American ducks, geese, and swans has appeared and is fulfilling the expectations of all those who were aware of the author's lifetime devotion to this enormous task. The book is attractively produced on high quality paper with an easy to read typography, plain design, and sturdy binding.

In the introduction, the author outlines the proce-

dure she has followed in the preparation of the book and defines the parameters used in her descriptions of young birds as well as problems related to the use of live birds versus museum specimens when describing colours of plumage or soft parts. This is an extensive part where many aspects of young waterfowl biology are discussed succinctly but adequately for the non-initiated reader to obtain a full understanding of the text related to each species. Colours and their nomenclature are treated with particular care as they are used extensively in the rest of the book and because the identification of several species in down plumage depends on an accurate colour evaluation.

Fifty-three species are treated in the book and the author has followed her own taxonomic arrangement to present the information. Each tribe is introduced by a section on its distribution and taxonomy followed by another on the general appearance of the birds and their behaviour. Within each tribe, the following information is given for every species, English, French, and Spanish names, scientific name, author, appearance, variation, source of specimens, and other references; a short section called "discussion" is frequently inserted after the section on variation.

The sections on appearance and variation of each species are particularly useful as the author describes the downy plumage in great detail and gives a complete summary of the known variation, including that of the soft parts coloration (bill, legs, eyes). These descriptions when read carefully will provide the necessary information for the identification of any downy young either in the field or in the laboratory. The author is particularly careful in her descriptions and in the use of colour terminology so that the text is clear and easy to understand. The discussion following many species contains information on a variety of topics such as behaviour, anatomy, measurements, colorations, and field identification in relation to the findings of other authors as reported in the literature. A list of the specimens used by the author appears in the section entitled "Source of specimens" and a shorter section, "Other references", lists references peculiar to the species where it is included.

The part dealing with "References" contains twenty-five pages and appears to be complete at least up to the publication of the book. It is followed by the three appendices and a table of contents.

The first appendix gives a list of measurements in metric units for all the species treated at some or all the standard stages of development from 8 to 96 hours, and includes mass (weight), exposed culmen, two tarsal lengths, and middle toe with claw. Appendix B is entitled "Color Descriptions" and deals with a detailed depiction of the colours of the down plumage as well as that of the soft parts called here "unfeathered parts" of all the species dealt with in the book. The colour descriptions are meticulous and based on the Munsell colour notation which provides an indispensable and bias free element of comparison. "Appendix C" entitled "Identification Keys" constitutes an important part of the book. It starts with a key to genera and is followed by keys to species within each genus. This part can be considered as one of the highlights of the work. In addition to the succinct but precise text, the outstanding black-and-white line drawings of each species complement the text and provide the necessary information for accurate identifications of downy young. The illustrations are of an unusually high quality and can suffice in many instances for identifying an unknown duckling without having to refer to the text. They are not only accurate but also delightful. This is where the author has contributed an outstanding accomplishment to waterfowl studies along with the ten color plates and life sketches scattered through the main text. The colour plates are exceptional in quality and reproduction to the extent that they could easily be considered as works of art. Form a scientific point of view, the postures of the birds are meticulous and the colours of the plumage and soft parts are accurate.

The taxonomic sequences and classification adopted by the author may not be in agreement with that of many recent proposals but this should not be an important issue at this time because the taxonomy of many groups, including waterfowl, is currently under review as a result of new techniques of analysis and current taxonomic studies. Results of future studies may support the taxonomic proposals of the author and may contribute to a better understanding of the evolution and relationships of these birds.

All those interested in waterfowl biology, particularly those who have to identify downy waterfowl, will find this book an essential reference in their study or work. The price is more than reasonable for a book of this quality. It is therefore with great pleasure that I recommend it to anyone working with waterfowl and also to anyone interested in birds in general.

HENRI OUELLET

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## Last of the Curlews

By Fred Bodsworth. 1995. Counterpoint, Washington. 192 pp., illus. U.S. $15.

The vast number of Eskimo Curlews of the past century were decimated by market hunting, not an unfamiliar story in North America. What is riveting about this species is the tantalizing hints of its lingering as a few scattered survivors still occasionally reported along the traditional spring and fall migration routes, mixed with flocks of other shorebirds, some similar enough in appearance to leave a element of doubt to sight identifications.

This slim volume is a reprint of the 40-year-old-classic, originally published in 1955 by Dodd, Mead & Company, in which Bodsworth imagines a year in the life of a surviving Eskimo Curlew, and in doing so graphically re-creates its behaviour and ecology centred on its nine-thousand-mile migration route from the far north of North America to the far south of South America. Particularly poingant is a fleeting companionship with a potential mate which does not survive to the nesting grounds. Although this is biology from a personal birds-view of events, instinct is stressed. An effective text contrast is provided by stark verbatim excerpts from the scientific literature which introduce many chapters.

This edition is illustrated by Abigail Rorer who has redrawn from the originals by the late Terry M. Shortt. It begins with a forward by W. S. Merwin outlining his personal discovery of the book and subsequent championing of its re-printing. Fred Bodsworth has added an Epilogue documenting the scattered evidence of Eskimo Curlew survival in the past four decades, and Murray Gell-Mann an Afterward touching on other North American abundant species decimated by over-exploitation and why we should care, ending starkly: "The human race must get used to the simple idea that the Earth is really finite. The sooner this happens, the happier the outcome will be."

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## Bats: A Community Perspective

By James S. Findley. 1993. Cambridge University Press, Cambridge. xi + 167 pp., illus. U.S. $19.95.

This is a good book for professional community ecologists working on bats or interested in comparing their study species with bats. The first third of the book is somewhat introductory: chapter 1 justifies the study of bat communities. Much is made of the fact that bats are exceptional, being small yet K-selected mammals who live in stable habitats. Chapter 2 provides brief descriptions (3–6 sentences) of each bat family and their habits. The non-chiroptologist will do well to read this section carefully, as family or genus names regularly appear in the rest of the book. Chapter 3 gives an overview of the methods used in the field to catch bats and to determine their movements, interactions, and diet. This chapter ends on a presentation of ecomorphology, an analytical field which uses multivariate techniques to group morphologically similar species in the hope that ecological similarities will be reflected in such groups.

The remaining two-thirds of the book is where the beef is for the community ecologist. Chapter 4 describes the bat communities of the following five geographical regions: temperate North America, Europe and Russia, tropical Africa, tropical Asia and Australia, Central and South America. Exhaustive tables list the species found at various sites within these zones, sometimes with abundance indexes. Chapter 5 looks at the influence of food, foraging areas, roosting sites, heat, and water, and concludes that although some of these factors may be limiting to bat populations, competition for them does not appear to be important. Chapters 6 and 7 deal with the global pattern of bat distribution in terms of species number, biomass, and trophic types. The first of these two chapters is more descriptive, with a lot of ecomorphograms, whereas the second one is more analytical, concluding that bat diversity seems to depend on habitat area and on the number of ancient or modern refuges (partitions in habitat).

Chapter 8, a 5-page summary where parallels are established with plants, birds, rodents, and freshwater fishes, ends by restating that bat species seem to have arisen in refuges and managed to coexist thereafter, without much evidence for the role of competition and resource limitation. Proponents of these two concepts as important factors shaping communities can take solace in several studies mentioned in the book where competition was apparent, and in the author's admission that, as a whole, studies in the field of bat communities are still relatively few, owing to the difficulty of studying a nocturnal animal for which species are sometimes hard to identify in the hand. Notwithstanding this last comment, the author did a good job of reviewing the literature, giving 206 references.

The book is well produced, although I did catch six typos and found graph lines to be too thin. The writing gets technical in places (particularly where ecomorphology is concerned) but it is otherwise clear, and the summaries at the end of each chapter, if not at

the end of chapter sections, are well done. The book is part of the Cambridge Studies in Ecology series; it is too specialized for the field naturalist, but community ecologists should find it useful.

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## No Room for Bears: A Wilderness Writer's Experiences with a Threatened Breed

By Frank Dufresne. 1991. Alaska Northwest Books, Bothell, Washington. 252 pp., illus. Reprinted from 1965 edition. U.S. $12.95; $15.95 in Canada.

Dufresne draws upon years of personal experience with people and bears to craft first-hand accounts of human behaviour in bear country and the response of bears to the people they encounter. While some chapters address black bears and polar bears, most of this book focuses on the brown bears of Alaska. There are many interesting, and sometimes chilling, accounts of human-bear encounters at the fire side, in tent camps, around fishing holes, at photographer blinds, and at remote cabins.

Dufresne rounds the book out with information about bear biology, evolution, and folklore; he makes anecdotal reference to bear species inhabiting other continents as well. In addition to bear mortality through direct encounters with humans, Dufresne addresses threats to the Alaskan brown bear resulting from habitat alienation and destruction. In his plea for the preservation of North American bears, Dufresne provides a series of recommendations for people living and working in bear country.

Because this book was written in 1965, some of the information on bear biology and evolution is outdated. But for those interested in mid-century human-bear interactions, this book will make a worthwhile addition to your library.

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## Bird Life of Woodland and Forest

By Robert J. Fuller. 1995. Cambridge University Press, New York. xiii + 244 pp., illus. U.S. $64.95.

This is an excellent and well-written account of woodland birds in Britain. Overall, the book is readable, informative, and provides interesting insights and questions about bird life in forested habitats. It is unfortunate that the book deals largely with British birds which might limit its interest to Canadian naturalists.

The book is well organised and the initial chapters provide a historical perspective on the forests of Britain and Europe followed by a discussion of how birds use woodland habitats. A chapter on the abundance and distribution of woodland birds is well thought out and discusses factors which determine the diversity of birds. Comparisons with avifaunas in mainland Europe and North America are made where appropriate and the book is well referenced throughout. The book has chapters on broad-leaved forest, coniferous forest, scrub forest, and upland woods, and includes sections on human managed "woodland" systems such as coppice, wood-pasture, and heath.

One aspect of the book that I found refreshing was the insights into bird distribution and behaviour which reflect the dynamic interactions between many species of birds and their habitats. The long history of human intervention in forested habitats in Britain, well over 2000 years, has left no old growth forest and very little mature forest; the majority being variously managed types of forests. Associated with changes in management of forests and their species composition have come changes in the distribution of birds. Dr. Fuller's reference to the general change in the habitat of the mistle thrush over a hundred years or so, from coniferous forests, through deciduous forest to largely suburban habitats indicates the adaptability of some species to changing environments. Likewise, the variation in habitat use in different parts of a bird's range, indicate the difficulty in finding appropriate indicators for measuring the health of forests. In central and eastern Europe, coal tit, goldcrest, bullfinch, and mistle thrush use coniferous habitats while in Britain they may be found in a range of deciduous habitats.

Major concepts of bird distribution such as edge effects, patchiness of habitat, and stand structure are discussed. Dr. Fuller draws on a wide personal background of research as well as that of the British Trust for Ornithology and other researchers and naturalists to make this a valuable book. The inclusion of a chapter on woodland in a changing countryside provide much food for thought and provide an understanding of how man's use and management of forests through millennia have affected the distribution and abundance of birds.

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## A Supplement to Distribution and Taxonomy of Birds of the World

By Charles G. Sibley and Burt L. Monroe, Jr. 1993. Yale University Press, New Haven, Connecticut. vi + 108 pp. US $25.00.

The publication in 1990 of *Distribution and Taxonomy of Birds of the World* by Charles G. Sibley and Burt L. Monroe became a landmark in ornithological literature (see review in *The Canadian Field-Naturalist* 107: 377–378, 1993) in spite of the fact that the classification proposed in it continues to be challenged. The authors did not consider their work as definitive and asked for suggestions or corrections. Readers responded to their request and "extensive" comments and suggestions were received. These and the changes identified by the authors form the basis for the current supplement.

The supplement is divided into two parts and consists of a detailed account and compilation of the changes and corrections from the original work. The first section is short (13 pages) and deals with changes in classification, including sequences of species, and adjustments in scientific and English names. The second part (pages 14–108) is entitled "complete update" and comprises all the modifications that the authors have brought their initial text. They have revised the species counts for all categories where such counts appeared in the earlier book. The changes deal mainly with the results of recent taxonomic work at the species level resulting in the recognition of species splits which resulted in different species counts at the higher taxonomic categories. On the other hand, the overall classification at the higher taxonomic levels, based on earlier work on DNA-DNA hybridization by Sibley and associates, remains as in the original book. Corrections and amendments to the original publication affect all sections including the world numbers, maps, gazetteer, references, and index.

The present work is a soft-cover book that will be indispensible to all who need to consult the original volume or use its information but the high price of both works, particularly of the supplement, may dissuade many potential buyers. It is hoped that all libraries where the original work is available will acquire the supplement.

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## A World Checklist of Birds

By Burt L. Monroe, Jr. and Charles G. Sibley. 1993. Yale University Press, New Haven and London. xiv, 393 pp. U.S. $50.00.

This typical checklist contains the 9702 species and 2063 genera recognized by Sibley, Ahlquist, and Monroe in their earlier works, including a recent supplement. The classification adopted in this book is identical to that of their earlier books and has become "a taxonomic listing in the Sibley-Ahlquist-Monroe (SAM) classification". A section on how to use the checklist appears in the short introduction and is followed by a list of the abbreviations and symbols which are abundantly used in the text. The book includes all the taxonomic categories found in the SAM classification, as well as an updated number of genera and species.

Each species occupies a single line and the scientific name is preceded by a box allowing one to record the sighting of that species. The English name follows with a brief outline of the geographic distribution and status of the species depicted by abbreviations and symbols given in parentheses. Initially, the abbreviations may be confusing to follow but one becomes familiar with them after having referred to the introduction a few times. The species line ends with a space permitting the user to register brief comments.

Because the SAM classification is different from those used by the majority of ornithologists and bird watchers, the index of genera will be a useful tool to locate species in the list for those familiar with scientific names. Likewise, the extensive index of English names will be appreciated by those searching for the position of species in the list and who are not familiar with scientific names or the SAM classification.

This checklist is a high quality production with good typography, clear design, compact format, excellent binding, and strong paper. This may explain its high price. It should be useful and appreciated by those who keep records of their sightings of birds anywhere in the world and by those who have to refer to a complete listing of birds of the world in their work or studies.

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## Anolis Lizards of the Caribbean: Ecology, Evolution, and Plate Tectonics

Jonathan Roughgarden. 1995. Oxford University Press, New York. xvi + 200 pp. U.S. $44.50.

The past 20 years or so have seen a revolution in evolutionary ecology. Much of this revolution is due to the development and application of mathematical models. Catalyzing this advancement is the advent of desktop computers. Virtually everyone can now follow the models, and understand the predictions derived from them. Roughgarden, a recognized leader in the field of theoretical ecology, has apparently taken the next logical step in education, that of lucidly providing the theoretical basis of ecological theory, along with the software to examine the consequences and predictions derived from various foraging strategies. Unfortunately, the PC software package designed to accompany the book must be purchased separately ($22.50), and was not provided for review by the publisher. (Reader beware: the software package "is intended for readers familiar with computer programing.")

Roughgarden's new book is an attempt to synthesize ecological, evolutionary and biogeographic theories. The central topics include the mathematical models and applications for foraging strategies, community assemblage, and food webs. He provides a discussion on the evolution of body size, competition, and coevolution. He has attempted to intertwine these data with geological development to formulate a new vicariance theory for the evolution of the insular anoles. The goal of the book is very lofty, and, unfortunately some of these goals fall far short of being realized. For example, although Roughgarden's expertise in theoretical ecology is clearly evident, his understanding of the application of phylogenetic methods to questions of evolution is wanting. A sound phylogenetic analysis is central to discussions of evolution, be it body size, colonization sequences, or ecology. Much of his "phylogenetic analysis" has little to do with phylogeny, but rather is aimed at a controversy over whether character displacement has occurred once (the most parsimonious, but not preferred explanation) or several times. As evidence for his point of view, Roughgarden cites an unpublished phylogenetic study that used size characters evaluated by generalized gap coding. Apart from the circularity of evaluating the evolution of size on a phylogeny constructed from size, generalized gap coding has been shown to be a poor, if not outright invalid, method for coding data. The extent of the phylogenetic methods problem is obvious from his primary "cladogram" (Figure 3.2). It has albumin immunological distances (AID) as synapomorphies! Evidence for one node is cited as "Genetic distance between *wattsi pogus* and other *wattsi* populations is greater than the distance between *w. schwartzi* and *w. wattsi*." Cladograms should be based on inheritable characteristics, and organisms do not inherit genetic distances.

There are other problems with the text that reveal a dated approach to biogeography and systematics. For example, in 1989 the anole lizards became members of the family Polychridae, and not Iguanidae; the former Iguanidae now consists of eight families. Similarly, the lizard family Agamidae has been subsumed as a subfamily into the Chamaeleonidae.

Apart from the theoretical ecology, the book has little to offer. Overall, it is a wealth of information on theoretical ecology as it applies to anole lizards and is exceptionally easy to read, especially if one is well-versed in math. However, the conclusions about the evolution of the group, and their biogeography, must await a sound application of phylogenetic methodology.

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## BOTANY

### An Orchid Flora of Puerto Rico and the Virgin Islands

By James D. Ackerman. 1995. New York Botanical Garden, Bronx, New York. 203 pp., illus. Cloth US $35.00

Floras are essential tools of biologists because they provide a basis for research and for the understanding and management of biodiversity. We need good floras and we need a lot more of them. Any good flora is a very significant contribution. This orchid flora contains descriptions of 145 species as well as information on distribution, habitat, flowering time, pollination, and classification. There are 97 plates illustrating approximately that many species as well as keys to genera and species. The book concludes with an explanation of the excluded species, literature cited, checklist and classification, a valuable glossary in both English and Spanish, and an index to scientific names.

Ackerman's book is a very significant contribution. It is a model flora. The keys are mostly well constructed, and the illustrations range from good to very good quality. It is accurate, easy to use, current and essentially complete with respect to the information available and the species covered. The fact that the keys are in both Spanish and English reflects a very sensible decision to increase communication and utility since Spanish is the major language of researchers in the surrounding region. The "taxonomic notes" are especially useful in explaining decisions of the author regarding classification and sometimes even providing rather extensive taxonomic histories and new information on patterns of variation.

This flora will be of use to anyone interested in the plant life of the region covered. It will also be of great value to specialists in orchid systematics and ecology, and researchers generally. Orchid growers and hobbyists may also find it useful, but of limited scope.

The only areas where this book falls a little short are in the four-page introduction and the alphabetical sequence of genera. Genus names change and when things are organized that way one cannot always find them easily. To identify plants and collect information about related groups it helps to have all related and similar groups together. That is the reason for a phylogenetic classification system, for expending effort to develop a reliable system, and for using it. Users of floras however, often disagree on the relative merits of phylogenetic versus alphabetical organization.

The introduction briefly describes geography, climate, the six life zones, orchid collections providing the basis for the work, species richness, endemics, geographical associations, and text organization. Considering that all these subjects are covered on four pages the reader can imagine that "brief" is given new meaning. However, in these days of constraints on funding, it is increasingly necessary to frame work within the needs and interests of the largest possible user group, and to provide justifications and fit work into a bigger picture. That is why an introduction is an opportunity. A few pages on orchid conservation in Puerto Rico would have been interesting in view of the fact that the majority of the orchids in Puerto Rico evidently occupy an ecological zone (lower montane rainforest) that covers less than 0.1% of the island. This must certainly mean a challenge for conservation efforts. Details on patterns of occurrence, major contributions of orchid research on the island to orchid biology, and biology generally (there have been some), more details on how this work fits into the larger region, a brief discussion of research directions for the Carribean region would all have been useful. Even a paragraph introducing the biggest and one of the most taxonomically complex (and irresistable) plant families in the world would have taken advantage of an opportunity. The 20 000–25 000 species indicated under the family description by Ackerman is a conservative estimate.

The introduction is lacking in illustrations and diagrams. Only one map is included (political subdivisions on the endpapers). Consequently it is hard to get a quick handle on the place and the orchid flora.

In summary we have here a model flora with a brief introduction and an alphabetical instead of nearest neighbour arrangement. It is reassuring to see a prominent scientist like Ackerman (at least 50 refereed papers of exceptional quality on ecology, pollination, and systematics) step away from the frontier for a while to provide a foundation for future research and help us cope with the biodiversity outside the front door.

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ENVIRONMENT

## Radiation Hazards to Fish, Wildlife and Invertebrates: A Synoptic Review

By Ronald Eisler. 1994. Biological Report 26, Contaminant Hazard Reviews Report 29, U.S. Department of the Interior, National Biological Services, Washington D.C. 20240. 124 pp., illus. No cost.

Ronald Eisler has compiled data from a large list of sources to provide a compendium of reported hazards to various types of wildlife. His introductory chapter gives a brief explanation of ionising radiation, radionuclides, and measurement terms. He then looks at both natural and human-generated sources of radiation in terms of their origin and potential magnitude. The next chapter, on radionuclides in the environment, is broken into sections on abiotic material, aquatic ecosystems, birds, and mammals. Finally he looks at the effects of radiation on several forms of living organisms. The information is drawn from 352 references listed at the back of the report, along with a short glossary.

My immediate reaction to this work was that the author had produced a compact useful reference that I would use time and again. I did have some misgivings about the inferences created by the form of the sentences. For example, he often lumps nuclear power and weapons together in the same phrase. The reader is left with the impression that these sources contribute equally to human dose. Later, when he discusses the data, you can see the measured difference in contribution but it can be hard to shake those first impressions. Some paragraphs have a curious sequence of sentences. The section on the Great Lakes tells of "significant" amounts of radioactivity from reactors and mine waste but gives no data to establish what is meant. The second sentence talks of "low levels" of fallout nuclides and is followed by a table of results with a cumulative total of over 21 x $10^9$ Bq/km$^2$. Incidently it is unclear how this table was derived and if it accounts for decay over the 30 year collection period.

As I dug deeper I became more concerned. I began to question the data itself. Table 5 is a typical annual whole body dose from all sources. Global weapons fallout is quoted as 0.05 mSv, a little on the high side (0.04 mSv is a more typical estimate) but not worth an argument. Table 7 shows a breakdown by nuclide of this fallout dose. The total from fallout is 4.45 mSv. The author notes this is 1.85 times natural background but does not question or comment on this unusually high figure. For comparison the average annual dose to Canadian atomic workers in 1994 was 2.86 mSv.

A potentially confusing point is the practice of quoting doses to animals in mSv units, which is the unit used for equivalent and effective doses in humans. The relationship between absorbed dose and equivalent and effective doses has not been established for non-human species. It would be preferable to state the dose in units of absorbed dose, i.e. the gray (Gy), and provide information on the type of radiation. This inconsistency may not stem from the author but those whom he is quoting. Nevertheless, he needs to explain the limitations on the data presented.

Much of the time I noted that the questionable data came from a few specific references that I was not familiar with. I reviewed the reference list and realised that many Canadian authors were missing. There is no mention of Swanson and her colleagues at University of Saskatchewan, of Brunskill and coworkers at the Experimental Lakes Area or of Sheppard at AECL'S Pinewa research unit to name a few. I felt I was being parochial by thinking only of Canadians so I checked for European material and I was left wondering. There are only two IAEA documents quoted out of the whole library of reports produced by that agency.

Finally when I came to use this document to find out information I had a hard time. I wanted to know the lethal dose to bacteria. The first problem I encountered is the lack of an index so you have to thumb through the document. I eventually found a value for protozoans, as close as I could come to bacteria, in a large table. It was some time later I noticed a small bar chart that included bacteria and was able to estimate that ten to over 10 000 Gy were required to achieve a 50% death rate.

This is a useful reference report and I believe I will find that I will use it frequently. However, I will not use the data from it until I have verified its accuracy. I would prefer that it be rewritten into a text I can both use and trust. The author needs to remember that this is a U.S. Government publication and this automatically confers a level of credibility. The author is responsible for ensuring the information given is accurate and can be read in context. A good editorial stance is needed to produce statements that are understandable and cannot be misquoted.

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## Prehistoric Alaska

Edited by P. Rennick. 1994. Alaska Geographic Volume 21, Number 4. The Alaska Geographic Society, P.O. Box 93370, Anchorage, Alaska 99509-3370, U.S.A. 112 pp., illus. U.S. $19.95.

*Alaska Geographic*, published since 1972, produces quarterly issues, each thematic and focussed on a specific aspect of Alaska's geography or natural history. This colourful and interesting issue concentrates on "Prehistoric Alaska", referring to all geologic time. It consists of eleven main chapters; most chapters are written by scientific experts, a couple are contributed by professional writers. The first four chapters deal with geologic and palaeoenvironmental themes; the final seven chapters focus on the region's human history.

The opening article ("Prehistoric Alaska: The Land" by F. H. Wilson and F. R. Weber) describes the geologic development of Alaska and is preceded by a timeline for orientation. This chapter concentrates on the assembly of the various terranes that make up the region. It leaves an impression of a highly mobile system, albeit on a vast time-scale. Although forming the immediate background and context for the human history, less attention is paid to Quaternary glaciation or geomorphology. Though it includes a series of maps, I found this chapter heavy-going and hard to follow. "The Terrible Lizards" or dinosaurs are next, described by staff writer L. J. Campbell and accompanied by a dinosaur bestiary. Dinosaur fossils from Alaska are a relatively new discovery. Despite hints in the 1960s and 1970s, major finds were only made in the 1980s. Serious scientific attention and exploration for new sites have occupied barely a decade. Most fossil have been recovered from the Colville River valley, not far inland from the Arctic coast. Dinosaur remains in such high latitudes have important implications for the interpretation of their ecology. Campbell emphasizes that Alaska is a huge area that will take many years to survey for suitable fossil localities and that there are few people and restricted funds for doing the work. The same comments could equally well apply to the archaeological resources discussed later. The dinosaur discussion places emphasis on a Late Cretaceous Land Bridge connection between Asia and North America. This is not mentioned in the geology section and, indeed, the illustrations included in that chapter leave the impression that there has been no such land connection until the Pleistocene.

The next two chapters ("Alaska Vegetation: What the Fossil Record of the Past 20 Million Years Shows" by T. Ager and "Pleistocene Mammals" by P. E. Matheus) focus on biological themes arising from the botanical and faunal records from Alaska. Our modern image of Alaska as windswept tundra and coniferous forest needs modification. Ager's discussion shows that Alaska has at times, such as the Early and Early-Middle Miocene, supported broadleaved thermophilous trees, such as lime (*Tilia*), hickory (*Carya*), and elm (*Ulmus*). These remains also suggest that the climate was considerably warmer than present, Ager estimates by up to 12° – 18°F mean annual temperature. Widespread coniferous vegetation has developed since the late Tertiary. These ancient forests and grasslands ("Mammoth Steppe") were inhabited in the late Pleistocene by a varied assortment of now extinct and extant fauna, including the eponymous mammoth. Matheus presnets an interesting discussion of the mammals' ecology, showing how they could co-exist by exploiting slightly different niches in the Beringian landscape. He tackles the fascinating question of the demise of the Pleistocene megafauna by offering two linked explanations. Changing environments may have made the terrain less favourable for some species, such as camels and horses, which are extirpated in Alaska although living elsewhere, and mammoths, which are extinct. Matheus suggests that other mammals, especially carnivores such as cheetahs and lions, were simply too specialized to be capable of exploiting the changed Beringian environment. Animals that had the most success were those such as wolves and brown bears that could exploit a variety of prey species and had more eclectic dietary habits.

The human history section opens with a background article by W. Workman ("The First of the Last: Pioneer Human Settlers on the Last Frontier") that provides a succinct chronologic survey of the main archaeological subdivisions in Alaska. The next five short chapters each concentrate on a different region and/or site in Alaska. Workman outlines several themes in Alaskan archaeology including the role the region played in the initial incursion of people from Asia to North America, whenever that might have occurred. From his account, the oldest generally-accepted archaeological sites found so far in Alaska date to the millennium 12 000 – 11 000 yr BP. Two of these ancient sites are highlighted in these chapters. Science writer Lee Dye describes the Mesa site, located on the north slope of the Brooks Range, which may date to 11 700 yr BP. The account of the furore surrounding the press conference to announce the site called by the Bureau of Land Management makes for instructive reading: the public found it fascinating, some colleagues found it outrageous. The importance of serendipity in site discovery is clear from this account. D. R. Yesner and K. J. Crossen introduce the Broken Mammoth site in central Alaska where the earliest archaeological remains date from about 11 800 yr BP. Whether these and similarly-aged sites really record "the environment and lifeways of the first Alaskans"

(page 92), as Yesner and Crossen claim for the Broken Mammoth site, remains a matter of controversy. What is clear, however, is that by the early Holocene people were established throughout Alaska. Among the slightly later sites are Trail Creek, dating from 9500 yr BP, mentioned by Jeanne Schaaf in her discussion of "Seward Peninsula Prehistoric Lifeways", and Ground Hog Bay in the Alaska Panhandle, also dating to 9500 yr BP, included in W. M. Olson's survey of "A Prehistory of Southeast Alaska".

Workman comments that "the question of early man is only one of a number of interesting and important topics in Alaska archaeology" and makes the point that "recent prehistory is both more approachable ... and perhaps of greater relevance" to today's Aboriginal people (page 75). On this theme, D. W. Veltre describes the problems of reconstructing pre-Contact Aleut cultures from the fragmentary archaeological record and oral traditions. Some sites may have considerable antiquity; Veltre mentions that the location of the modern village of Nikolski may have been continuously occupied for the last 4000 years. Much of Olson's discussion of southeast Alaska also concentrates on later prehistory, especially the emergence of the varied coastal Aboriginal groups. A captivating narrative by Herbert Anungazuk, describing a prehistoric hunter's experience of whale-hunting in western Alaska, puts a human face to the archaeology.

The authors in this section adopt a conservative position and espouse a late entry (post-Late Wisconsinan maximum) position for the first migration of people into North America via Alaska. On this theme, the final chapter, "Molecular Evolutionary Genetics of Indigenous Northern Populations", is an attempt by G. F. Shields to put a more objective spin on this debate. Shields reports on studies of mitochondrial DNA, which is transmitted through the female line and can be used as a "molecular clock". These analyses show groups of different genetic diversity. Mapped data show clear differences between Aboriginal populations in northern North America (and Siberia) and those to the south. Shields points out some incongruities between the pattern and chronology produced by genetic and linguistic evidence, noting that genetic and linguistic groups do not coincide. It would be useful to compare these data with dental evidence analyzed by physical anthropologists such as Christy Turner.

The main body of the text is followed by a list of museums displaying relevant Alaskan geological, archaeological and ethnographic material, a glossary, a bibliography, and an index. The glossary consists exclusively of geologic terms. I think it would have been useful to include some archaeological terms, such as "component", "bifacial tools", and "burin". The bibliography contains much useful material. However, general and highly technical publications are combined. I would prefer these readings arranged in the same subdivisions as the chapters, making it easier for a reader to follow-up on a specific topic, with the more general readings, such as Dale Guthrie's excellent book on Blue Babe, highlighted in a "Further reading" section at the beginning. I was surprised that E. C. Pielou's outstanding book (*After the Ice Age: The Return of Life to Glaciated North America*) is not listed; as an accessible introduction to the complex topic of palaeoecology it would be a useful addition.

The text is profusely illustrated with maps, paintings, and especially colour photographs. Most of these images are excellent, particularly those illustrating the various archaeological sites. Having read much about Alaskan sites in recent years, I was especially interested in the archaeological photographs. These include artifact pictures and excavation scenes as well as general scenery shots. The pictures of Blue Babe and, in particular, the ground squirrel carcass (page 57) require scales. The photomicrograph of the pollen slide (page 42) needs an indication of magnification or scale. A location map (page 8) includes the sites mentioned in the articles. Among the illustrations are two major full-page paintings by local artist Tom Stewart, one of dinosaurs, the other of Pleistocene mammals. They are certainly eyecatching, although I must admit that personally I did not like them. The dinosaur painting in particular suffers by juxtaposition with the truly excellent reconstructions by Jan Sovak and Vladimir Krb. Although human history is the focus of a third of the text, this painting is used as the cover illustration,

Most writers have managed to keep the technical jargon to a minimum but there are a few places where it slips in. In this regard, the chapter by Olson stands out, including unexplained terms such as "detachment of platform tablets", and "moiety system". There are a few intrusive spelling and grammatical errors, e.g., "forbs" is consistently given as "forbes", and "gate" appears for "gait". Most chapters are clear, absorbing and well-written, but I did note some awkward sentence structures, especially in Campbell's contribution.

Writing for the public is very difficult — I speak here from personal experience — and the selection of material from such a vast region and subject-area must have been hard. This volume is a worthy endeavour and clearly represents the outcome of much hard work by the authors and production team. Criticisms aside, I feel that this issue of *Alaska Geographic* gives a valuable introduction to some fascinating topics in a complex and diverse region. It deserves to be widely-read.

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## Functions of Nature

By Rudolf S. deGroot. 1992. Wolters-Noordhoff, Groningen, Netherlands. 345 pp. illus. Nfe 80.

Twenty-first century historians will mine the stacks, CDs, computerized data bases, and many other yet to be invented electronic searching tools to examine humanity's march through time. From their computers will spill detailed and varied accounts of the forces, factors, and events that shaped the evolution of human culture, society, and economy. Historians will dissect, expose, highlight, analyze, and perhaps provide prophetic advice for their readers. And while human conflict will persist as a dominant theme of their "backgazing", I anticipate that humanity's struggle to find its place in the ecosphere will be a rich area of investigation as well.

I expect that the 1990s will be described as a decade of global chaos, of continued and increasing ecospheric degradation, of economic upheaval, and continued human conflict. But too, historians just may be able to describe the 1990s as a "turn around" decade, a decade in which societies throughout the World accepted and embraced the need for significant and unprecedented change, change characterized by a commitment to ecological sustainability, change focused on finding balance between people who use the ecosphere and the capacity of the ecosphere to provide for human survival, security, a sense of belonging, self-esteem, and self-actualization.

Among the thousands of books and articles available to them, historians will look for key documents that helped shape the 21st Century. *Functions of Nature* may well be selected for mention in the footnotes as one of the early attempts to comprehensively grapple with techniques to describe and value the many forces and factors that drive the Earth's ecosystems and the people who live and work in them. A primary purpose of the book is to contribute to the development of methods that translate environmental data into applied information for planning and decision-making in more objective and systematic ways.

In Chapters one and two, deGroot describes ecological evaluation and assessment methods, and defines 37 functions that he believes capture the spectrum of values required to plan for and make ecologically-based decisions. The functions are organized according to four themes. "Regulation Functions" reflect the capacity of the ecosphere to provide and regulate ecological processes and life-support systems. They include the regulation of energy balance, chemical composition of the atmosphere and the oceans, fixation of the solar energy and biomass production, and storage and recycling of organic matter, nutrients, and human waste. "Carrier Functions" characterize the capacity of ecosystems to provide space to meet the physical needs of humans, including habitation, cultivation, industry, transportation, recreation, and nature protection. The "Production Functions" define natural resources that humans use to survive and prosper, including air, water, food, fuel and energy, fertilizer, medicines, and raw materials for clothing. The "Information Functions" contribute to human psychological health by providing opportunities for educational, spiritual, and cultural development and experiences. Integrated planning and decision-making is a central theme throughout these two chapters.

Chapter three describes many of the values ascribed to ecosystems, outlines various methods available to assess the monetary value of environmental functions, and provides examples. Values include: conservation value, existence value, human health value, option value, consumptive use value, and productive use value. Chapter four contains three case studies employing these functions and values in a moist tropical forest ecosystem (Darien National Park in Panama), a temperate wetland ecosystem (Dutch Wadden Sea), and an oceanic island ecosystem (Galapagos National Park in Ecuador). In the concluding chapter, deGroot argues that the concept of "sustainability" must be a primary element in decision-making, and describes the use of the "functions of nature" in planning, environmental impact assessment, and cost-benefit analyses.

The text is punctuated with examples, illustrations, tables, and the parameters of the 37 functions are listed and defined in an Appendix. This is an important book for people working to understand ecological sustainability and the design and implementation of an ecosystem approach to management. It contributes to current efforts aimed at defining and implementing an holistic and integrated approach to caring for the ecosphere's natural assets, including the people who live and work in it. It is regrettable that deGroot did not write this book within the context of an ecologically meaningful spatial framework — a context in which people and organizations can use described and mapped ecosystems to understand and manage for the array of ecological, cultural, social, and economic conditions and forces at work in the World. Evaluating the ecosphere's natural assets and determining the roles and responsibilities of humans who live and work in it is a complex subject. deGroot has made a good start.

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## Biodiversity in Canada: A Science Assessment for Environment Canada

By Biodiversity Science Assessment Team. 1994. Environment Canada, Ottawa. 245 pp., illus. + 24 pp. summary volume. Free.

If you are looking for a book on the biodiversity of Canada, this is not it. Rather, this is a science assessement on biodiversity issues. What is a science assessement? The preface of the book claims that a science assessment "reviews the state of knowledge on a particular issue or topic in order to identify implications for policy and for further research."

Separate chapters address threats to biodiversity from a variety of land uses (e.g. forestry and agriculture) and other environmental pressures such as the introduction of exotic species and pollution. The books summarizes a vast amount of research on biodiversity issues, unfortunately the chapters are wildly uneven in their thoroughness. For example, the literature cited section alone for the chapter on agriculture is over twice as long as the entire chapter on forestry!

One of the strong points of the book is its focus on what should be done. Each chapter contains recommendations for additional research and policy directions. While some are needlessly vague, they still provide some guidance on these issues. It remains to be seen if the Government of Canada is indeed committed to preserving biodiversity. To decide for yourself if the government is heading in the right direction, you can obtain the complete book or a summary booklet (with the key recommendations) free of charge from Environment Canada in either English or French (819-997-1095).

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## Restorations of Endangered Species: Conceptual Issues, Planning and Implementation

Edited by Martin L. Bowles and Christopher J. Whelan. 1994. Cambridge University Press, Cambridge. xiii + 394 pp., illus. U.S. $49.95.

The reintroduction or restoration of endangered species is increasingly common as more and more species become threatened with extirpation or extinction. This handy volume compiles a number of papers, most of which were first presented at a symposium on the subject held in 1990. As the sub-title suggests, the papers tackle three main themes: 1) Conceptual Issues — from organizational guidelines for recovery teams to genetic considerations for viable populations; 2) Restoration Planning — case studies that outline factors that should be considered ahead of time such as the role of biological invasions on the management of rare plant species and the effects of metapopulation dynamics on the long-term success of restorations; 3) Implemented Restorations — results of various restoration projects that have been undertaken, including the swift fox program in western Canada.

The strength of this book is its integration of different fields: theory and practice, botany and zoology. It's rare to see an article on caribou next to one on a thistle. Nonetheless, the diversity of fauna covered could have been broader, as all three of the animal restoration papers are devoted to mammals. Still, this is a valuable reference tool for wildlife managers and could be an excellent textbook for a senior level course in restoration ecology.

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## Everglades: The Ecosysem and Its Restoration

Edited by Steven M. Davis and John C. Ogden. 1994. St. Lucie Press, Delray Beach, Florida. xv + 826 pp., illus. + map. U.S. $110.

As humankind continues to gain knowledge of the biosphere it lives in, the significance of previous undisturbed ecosystems comes to light. With this enlightenment comes the realization of the need to attempt restoration of what once was. *Everglades: the Ecosystem and Its Restoration* is a treatise which provides the details of such an enlightment describing "details of the past and present Everglades," with "its justification" only being "realized in the future Everglades."

The book is stated to be "an outgrowth of the 1989 Everglades Symposium in Key Largo, six adaptive environmental assessment workshops, intensive communication and interaction among contributors … of topics through 1992." *Everglades* has a contributing authorship of 57 authors with 27 institutional affiliations. There are 31 chapters, with an emphasis on

hydrologic aspects, organized in five sections: (I) The Everglades Issues in a Broader Perspective, (II) Spatial and Temporal Characteristics of Ecosystem Driving Forces, (III) Vegetation Components and Processes, (IV) Faunal Components and Processes, and (V) Toward Ecosystem Restoration. Each chapter has an abstract. The text is organized in a logical and very readable manner.

Davis and Ogden provide a detailed overview of a unique ecosystem and its problems. One lesson the book emphasizes is the enormous cost disruption of a key ecosystem and the resulting attempt at restoration can have. A restoration which, as the editors state in the final chapter, will provide a new Everglades, not the Everglades of the past, and if successful will rekindle the wildness and richness of the former system. The book is not the final chapter in the restoration of the Everglades but an update and identification of possible future direction. *Everglades: the Ecosystem and Its Restoration* should be of interest and a good read to those with an interest in the Everglades as well as wetland restoration.

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## Reinventing Nature? Responses to Postmodern Deconstruction

Edited by Michael E. Soulé and Gary Lease. 1995. Island Press, Washington, D.C. xvii + 186 pp., illus. Cloth U.S. $34.95. Paper U.S. $17.95

The world of humanities often questions the validity of the scientific or technical view of nature. In *Reinventing Nature* the editors furnish a number of essays collected from a conference in Santa Cruz which was organized for an exchange of views between the worlds of the natural sciences and the humanities. At the conference and in the book the editors wanted to raise the question "whether perceptions and conceptions of nature … differ enough between cultures to affect the way these cultures would wish to maintain or manage nature in the remnants of remaining habitat."

Soulé and Lease provide the reader a dialogue from leading thinkers from the fields of philosophy, history, literature, public policy, forestry, and others. The reader is first provided the essay abstracts and then a short glossary. Both items are useful and ideally located for help while navigating through the discussion.

The discussion reveals "certain contemporary forms of intellectual and social relativism can be just as destructive to nature as bulldozers and chain saws." For this reason alone this book should be a must read for individuals in conservation biology, restoration, and ecology work to name a few. The editors provide a work which will provide a feast for continued dialogue on "nature".

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## NEW TITLES

**Adaptation and natural selection in caves: the evolution of *Gammarus minus*.** 1995. D. C. Culver, T. C. Kane, and D. W. Fong. Harvard University Press, Cambridge, Massachusetts. 223 pp., illus. U.S. $ 35.

**Atlas des oiseaux richeurs du Québec méridionol.** 1995. Par J. Gauthier et Y. Aubry. L'Association québecoise des groupes d'ornithologues, CP 1000 Succursale M, Montreal H1V 3RZ. xviii + 1295 pp., illus. $150. Available also in English.

†**Atlas saisonnier des oiseaux du Québec.** 1995. Par A. Cyr et J. Larivée. Presses de l'Université de Sherbrooke et Société de Loisir ornithologique de l'Estrie, Sherbrooke. viii + 709 pp., + transparent, illus. $56.95 au Canada; U.S. $56.95 extérieurs.

**A chorus of frogs.** 1995. By J. P. Hunt. Silver Burdett Press, Parsippany, New Jersey. 40 pp., illus. Cloth U.S. $14.95; paper U.S. $7.95.

**The company of wolves.** 1995. By P. Steinhart. Knopf, New York. xviii + 374 pp., illus. U.S. $25.

†**A critical review of the aerial and ground surveys of breeding waterfowl in North America.** 1995. By G. W. Smith. Biological Science Report 5. National Biological Service, Washington. iii + 252 pp., illus. Free.

**The grizzly bears of Yellowstone: their ecology in the Yellowstone ecosystem, 1959-1992.** 1995. By J. J. Craighead, J. S. Sumner, and J. A. Mitchell. Island Press, Washington. 560 pp., illus. U.S. $100.

**Hawks, Owls, and other birds of prey.** 1995. By. D. Fourie. Silver Burdett Press, Parsippany, New Jersey. 40 pp., illus. Cloth U.S. $14.95; paper U.S. $7.95.

**High country heritage: New England's mountain flowers.** 1996. By. J. Wallner and M. J. DiGregorio. Mountain Press, Missoula, Montana. 224 pp., illus. U.S.$16.

**Insects through the seasons.** 1996. By G. Waldbauer. Harvard University Press, Cambridge, Massachusetts. 304 pp., illus. U.S.$24.95.

**In the country of gazelles.** 1995. By F. R. Walther. Indiana University Press, Bloomington. ix + 162 pp., illus. U.S. $24.95.

***Masters of the ocean realm: whales, dolphins, porpoises.** 1995. By J. E. Heyning. UBC Press, Vancouver. 112 pp., illus. $24.95.

**The origins of right and wrong in humans and other animals.** 1996. By. F. deWaal. Harvard University Press, Cambridge, Massachusetts. 384 pp., illus. U.S. $24.95.

**The others, how animals made us human.** 1996. By P. Shepard. Island Press, Washington. 390 pp., illus. U.S. $24.95.

**The penguins: Spheniscidae.** 1995. By T. D. Williams. Oxford University Press, New York. xvi + 295 pp., illus. U.S. $60.

†**Proceedings of the 6th International Grouse Symposium.** 1995. Edited by D. Jenkins. Proceeding of a symposium Udine, Italy, 20-24 September 1993. World Pheasant Association, Reading, United Kingdom. iv + 175 pp., illus. £15.

**Seals and sea lions.** 1995. By D. G. Gordon. Monterey Bay Aquarium, Monterey Bay California. 64 pp., illus. U.S. $9.95.

***Shells of Atlantic and gulf coasts and the West Indies.** 1995. By R. T. Abbott and P. A. Morris. Peterson Field Guide Series. Houghton Mifflin, Boston. 350 pp., illus. U.S. $26.95.

**Whales, dolphins, and porpoises: the visual guide to all the world's cetaceans.** 1995. By M. Carwardine. Dorling Kindersley, New York. 256 pp., illus. cloth U.S. $ 29.95; paper U.S. $17.95.

***Where to watch birds in Africa.** 1995. By N. Wheatley. Princeton University Press, Princeton. 432 pp., illus. U.S. $35.

†**The wind masters: the lives of North American birds of prey.** 1995. By P. Dunne. Houghton Mifflin, New York. U.S. $22.95.

### Botany

**The book of rhododendrons.** 1995. By M. Kneller. Timber Press, Portland, Oregon. 160 pp., illus. U.S. $45.

†**Botanical reconnaissance of the Tuxedni Wilderness Area, Alaska.** 1995. By S. S. Talbot, S. L. Talbot, and S. L. Welsh. Biological Science Rept. 6. National Bilogical Service, Washington, 41 pp., illus. Free.

**Canada's vegetation: a world perspective.** 1995. By G. A. J. Scott. McGill-Queen's University Press, Montreal. xviii + 361 pp., illus.

**Ericas of South Africa.** 1995. By D. Schumann and G. Kirsten. Timber Press, Portland, Oregon. 274 pp., illus. U.S. $59.95.

**Flora of the Venesuelan Guyana, Volume 1: introduction and Volume 2: Pteridophytes, Spermatophytes (Acanthaceae-Araceae).** 1995. Edited by J. A. Stèyermark, P. E. Berry, and B. K. Holst. Timber Press, Portland Oregon. c400 pp., illus. U.S. $49.95 and c650 pp., illus. U.S. $ 65.

†**Flore laurentienne.** 1995. Par Frère Marie-Victorin. Troisième édition. Les Presses de l'Université de Montréal, Montréal. xv + 1083 pp., illus. $65.

†**Greenland lichens.** 1995. By. E. S. Hansen. Rodos, Copenhagen. 124 pp., illus. DK. 150.

***A history of the orchid.** 1995. By. M. A. Reinikka. Timber Press, Portland, Oregon. $40 pp., illus. U.S. $29.95.

**Lecythidaceae of a central Amazonian moist forest.** 1995. By S. A. Mori and N. Cunha. Memoirs vol. 75. New York Botanical Garden, Bronx. 55 pp., illus. U.S. $ 12.50.

**Manual of orchids.** 1995. Edited by J. Stewart. Timber Press, Portland, Oregon. 403 pp., illus. U.S. $49.95.

†**Mountain plants of the pacific northwest: a field guide to Washington, western British Columbia, and Southeastern Alaska.** 1995. By. R. J. Taylor and G. W. Douglas. Mountain Press, Missoula, Montana. vi + 437 pp., illus. U.S. $ 20.

**Nueva flora de Chile.** 1995. Editado por C. Marticorena y R. A. Rodriguez. Volume 1. Proyecto Flora de Chile, Universidad de Concepcion, Concepcion, Chile. Ch$ 20,900 (U.S. $70).

**Plants and their names: a concise dictionary.** 1995. By R. Hyamond and R. Pankhurst. Oxford University Press, New York. x + 545 pp. U.S. $29.95.

**The prairie keepers: secrets of the grassland.** 1995. By. M. Houle. Addison-Wesley, New York. 266 pp., U.S. $20.

†**Plants of the maritimes: a bibliography for agriculture, resource management, landscape planning, and biological research.** 1995. By P. M. Cattling, S. Porebski, and B. S. Brookes. CanaColl Foundation, 1010 Carling Avenue, Ottawa, Ontario K1A 0C6. 65 pp. $10.

**The rhododendron species, volume iv: azaleas.** 1995. By H. H. Davidian. Timber Press, Portland, Oregon. 184 pp., illus. U.S. $54.95.

*__Sonoran desert plants: an ecological atlas.__ By R. M. Turner, J. E. Bowers, and T. L. Burgess. University Arizona Press, Tuscon. 500 pp., illus. U.S. $70.

*__La symbiose mycorhizienne: états des connaissances.__ 1995. Êdité par J. A. Fortin, C. Charest, et Y. Piche. Orbis, Frelighsburg, Québec. viii + 195 pp., $24.95.

**Utah wildflowers: a field guide to northern and central mountains and valleys.** 1995. By R. J. Shaw. Utah State University Press, Logan. v + 218 pp., illus.

### Environment

*__Biodiversity and conservation of neotropical montane forests__. 1995. Edited by S.P. Churchill, H. Balslev, E. Forero, and J.L. Luteyn. Proceedings of a symposium, the New York Botanical Garden, Bronx, June, 1993. New York Botanical Garden, Bronx. 700 pp. U.S.$ 85.

*__Conservation biology in theory and practice.__ 1995. By G. Caughely and A. Gunn. xii + 459 pp., illus. U.S. $44.95.

**Ecology and management of tidal marshes: a model from the Gulf of Mexico.** 1995. Edited by C. L. Coultas and Y. P. Hsieh. St. Lucie Press, Delray Beach, Florida. c325 pp., illus. U.S. $59.95.

†**Ecology of infectious diseases in natural populations.** 1995. Edited by B. T. Grenfell and A. P. Dobson. Cambridge University Press, New York. xii + 521 pp., illus. U.S. $59.95.

†**An ecosystem approach to living sustainably: a perspective for the Ministry of Natural Resources.** 1995. By P.A. Gray, L. Demal, D. Hogg, D. Greer, D. Euler, and D. DeYoe. Ontario Ministry of Natural Resources, Peterborough. vi + 77 pp., illus. Free.

*__Evolutionary naturalism.__ 1995. By. M. Ruse. Toutledge, New York. x + 361 pp., illus. U.S. $49.95.

†**Expanding partnerships in conservation.** 1995. Edited by J. A. McNeely. Island Press, Washington. xvi + 302 pp., U.S. $34.95.

†**This fragile land: a natural history of the Nebraska sandhills.** 1995. By P. A. Johnsgard. University Nebraska Press, Lincoln. xv + 256 pp., illus. U.S. $35.

*__Fundamentals of conservation biology.__ 1995. By M. L. Hunter, Jr. Blackwell Science, Cambridge, Massachusetts. xiv + 482 pp., illus. U.S. $42.95.

**Guardians of the parks: a history of the National Parks and Conservation Association.** 1995. By J. C. Miles. Taylor & Francis, Washington. xviii + 363 pp., illus. U.S. $29.95.

**Invasions of the land: the transitions of organisms from aquatic to terrestrial life.** 1995. By M. S. Gordon and E. C. Olson. Columbia University Press, New York. xv + 312 pp., illus. U.S. $65.

**Marine conservation for the 21st century.** 1995. By H. Viders. Best, Flagstaff, Arizona. xvi + 350 pp., illus. Cloth U.S. $29.50; paper U.S. $24.95.

**The national parks of Canada.** 1994. By. K. McNamee. Key Porter Books, Toronto. 224 pp., illus. $45.

**The northern forest.** 1995. By D. Dobbs and R. Ober. Chelsea Green, White River Junction, Vermont. xxvi + 356 pp., U.S. $23.

**Our national park system: caring for America's greatest natural and historic treasures.** 1995. By D. F. Rettie. University of Illinois Press, Urbana. xvi + 293 pp., illus.

**Partnership for the planet: an environmental agenda for the United Nations.** 1995. By H. F. French. Worldwatch Institute, Washington, 71 pp., illus. U.S. $5.

*__A place to walk: a naturalist's journal of the Lake Ontario Waterfront Trail.__ 1995. By A. Karstad. Natural Heritage/Natural History, Toronto. 120 pp., illus. $19.95.

**The value of life: biological diversity and human society.** 1996. By S. R. Kellert. Island Press, Washington. 280 pp., illus. U.S. $24.95.

†**Wild ideas.** 1995. Edited by D. Rothenberg. Univeristy Minnesota Press, Minneapolis. xxvii + 225 pp., Cloth U.S. $49.95; paper U.S. $19.95.

†**Wild Thailand.** 1995. By B. Stewart-Cox. MIT Press, Cambridge, Massachusetts. 208 pp., illus. U.S. $40.

**The world of wilderness: essays on the power and purpose of wild country.** 1995. Edited by T. H. Watkins and P. Byrnes. Roberts Rinehart, Boulder Colorado.

### Miscellaneous

**Always Rachel: the letters of Rachel Carson and Dorothy Freeman, 1952 - 1964.** 1995. Edited by M. Freeman. Beacon Press, Boston. xxx + 567 pp., illus. U.S. $35.

†**Minutes of meetings, 1932 - 1935, of the McIlwraith Ornithological Club, London, Ontario, Canada.** 1996. By W. W. Judd. Phelps Publishing, London. iii + 106 pp., $10.

**Darwinism evolving: systems dynamics and the genealogy of natural selection.** 1995. By D. J. Depew and B. H. Weber. MIT Press, Cambridge, Massachusetts. xii + 588 pp., illus. U.S. $49.95.

**Illustrated dictionary of science.** 1995. Edited by M. Allaby. Facts on File, New York. 256 pp., illus. U.S. $29.95.

*__The year is a circle: a celebration of Henry David Thoreau.__ 1995. By V. C. Friesen. Natural Heritage/Natural History, Toronto. xvii + 123 pp., illus. $24.95.

**Books for Young Naturalists**

**African Elephants.** 1995. By R. Smith. Lerner, Minneapolis. 48 pp., illus. U.S. $14.21.

**Alligators.** 1995. By F. Staub. Lerner, Minneapolis, 48 pp., illus. U.S. $ 14.21.

**Animal behavior science projects.** 1995. By N. W. Cain. Witey, New York. x + 162 pp., illus. U.S. $12.95.

**Bats, bugs, and biodiversity: adventures in the Amazonian rain forest.** 1995. By S. E. Goodman. Atheneum, New York. 46 pp., illus.

**Birds.** 1995. By B. Taylor. Dorling, Kindersley, New York. 160 pp., illus. U.S. $5.95.

**A bold carnivore: an alphabet of predators.** 1995. By C. Powell. Roberts Rinehart, Boulder, Colorado. 28 pp., illus. U.S. $14.95.

**Of bugs and beasts: fact, folklore, and activities.** 1995. By L. J. Livo, G. McGlathery, and N. J. Livo. xxi + 215 pp., illus. U.S. $23.50.

**Dinosaurs.** 1995. By N. Clark and W. Lindsay. Dorling Kindersley, New York, 160 pp., illus. U.S. $5.95.

**Duck.** 1995. By S. Savage. Thomson Learning, New York. 32 pp., illus. U.S. $13.95.

**Exploring the world of animals.** 1995. By P. R. Durant. Watts, New York. 48 pp., illus. U.S. $19.30.

**Exploring the world of plants.** 1995. By P. R. Durant. Watts, New York. 48 pp., illus. U.S. $19.30.

**How do we know animals can think?** 1995. B. S. Parker. Raintree, Austin. Texas. 40 pp., illus. U.S. $15.95.

**How to be a nature detective.** 1995. By M. E. Selsam. Harper Collins, New York. 32 pp., illus. Cloth U.S. $14.95; paper U.S. $4.95.

**Insects.** 1995. By L. Mourd and S. Brooks. Dorling Kindersley, New York. 160 pp., illus. U.S. $5.95.

**Inside the amazing Amazon.** 1995. By D. Lessem. Crown, New York. 38 pp., illus. U.S. $18.

**An introduction to northern California birds.** 1995. By H. Clarke. Mountain Press, Missoula, Montana. ix + 189 pp., illus. U.S. $14.

**The manatee.** 1995. By A., V., and R. Silverstein. Millbrook Press, Brookfield, Connecticut. 64 pp., illus. U.S. $15.90.

**My shell.** 1995. By L. Patchett. Garth Stevens, Milwaukee. 32 pp., illus. U.S. $12.95.

**A nest full of eggs.** 1995. By P. B. Jenkins. Harper Collins, New York. 32 pp., illus. Cloth U.S. $14.95; paper U.S. $4.95.

**Outside and inside snakes.** 1995. By. S. Markle. MacMillan Books for Young Readers, New York. 40 pp., illus. U.S. $16.

**Owls: Whoo are they?** 1996. By K. Jarvis and D. W. Hold. Mountain Press, Missoula, Montana. 64 pp., illus. Paper U.S. $10; cloth U.S. $16.

**Primates: lemurs, monkeys, and you.** 1995. By I. Tattersall. Millbrook Press, Brookfield, Connecticut. 72 pp., illus. U.S. $16.90.

**Puffins climb, penguins rhyme.** 1995. By B. McMillan. Gulliver Books, San Diego. 32 pp., illus. U.S. $14.

**Sea turtles.** 1995. By. G. Gibbons. Holiday House, New York. 30 pp., illus. U.S. $15.95.

**The tree in the ancient forest.** 1995. By C. Reed-Jones. Dawn, Nevada City, California. 30 pp., illus. U.S. $6.95.

**The whale: giant of the ocean.** 1995. By V. Tracqui. Translated by T. Froggatt. Charlesbridge, Waterdown, Massachusetts. 27 pp., illus. U.S. $6.95.

**Whales.** 1995. By E. D. Stoops, J. L. Martin, and D. L. Stone. Sterling, New York. 80 pp., illus. U.S. $14.95.

**What's alive.** 1995. By K. W. Zoehfeld. Harper Collins, New York. 32 pp., illus. U.S. $ 14.95.

**Who eats what: food chains and food webs.** 1995. By P. Lauber. Harper Collins, New York. 32 pp., illus. Cloth U.S. $15; paper U.S. $4.95.

**Zipping, zapping, zooming bats.** 1995. By A. Earle. Harper Collins, New York. 32 pp., illus. Cloth U.S. $14.95; paper U.S. $4.95.

*assigned for review
†available for review

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# The Canadian Field-Naturalist

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**Cover**: A pod of Long-finned Pilot Whale, *Globicephala melas*, drawn by Dawn Nelson. See COSEWIC status report by Nelson and Lien, pages 511–524.

The Canadian Field-Naturalist

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# Endemic Vascular Plants of British Columbia and Immediately Adjacent Regions

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Douglas, George W. 1996. Endemic vascular plants of British Columbia and immediately adjacent regions. Canadian Field-Naturalist 110(3): 387–391.

Forty-six endemic vascular plant taxa are listed for British Columbia and immediately adjacent regions. These taxa occur within 12 endemic regions. These endemic taxa are of some importance thus resource managers should be aware of their conservation and preservation responsibilities.

Key Words: Endemic vascular plants, endemic regions, British Columbia.

Vascular plant floristics have recently become a topic of interest for many resource managers. These managers, often in response to public concern with conservation or preservation issues, are now attempting to deal with such issues as endangered species, biodiversity, old growth forests and gap analysis when developing protected areas strategies. When examining these, and other issues dealing with natural landscape features, the vascular plant flora of a region often becomes one of the main focal points. Some of the aspects examined during these floristic studies include the numbers of endemic plants, rare plants, threatened and endangered plants and their current status with respect to their extant occurrences. This paper examines the endemic vascular plants of British Columbia and immediately adjacent regions.

Forty-six plants, which have all or a large part of their range in British Columbia, are considered here. These plants were chosen for both geographical and political reasons. In the majority of cases the rare plants of a political area, such as British Columbia, are peripheral species which have more extensive populations outside the area considered here. Although all possible efforts should be expended to preserve these populations (which may contain unique genetic material and are part of a region's distinct natural biodiversity) it may not always be catastrophic if these efforts sometimes do not succeed. Nearby populations in other jurisdictions may not be much different due to the restricted range of the plant(s) in British Columbia. Of greater concern are those plants which have all or a large part of their range within British Columbia. These regional endemics are especially important if their present populations are not secure from a conservation standpoint. Of the 46 regional endemics treated in this paper, 34 are currently being tracked by the British Columbia Conservation Data Centre, an agency which has the responsibility of tracking over 600 provincially and globally rare native vascular plants existing within the province. It is therefore the responsibility of provincial resource managers to ensure that these 34 endemics, and many of the others which may become vulnerable in the future, retain their viability through adequate habitat protection. It is also the responsibility of the latter managers to convince managers in other political jurisdictions that they too should take part in the conservation strategy for each of these endemics.

The 46 regional endemics treated in this paper occur within 12 endemic regions. Only one of these regions, that associated with the Queen Charlotte Islands, has been well documented with respect to endemics (Calder and Taylor 1968). Some of the taxa in other groups have been mapped in regional floras (e.g., Hulten 1968; Packer 1983) or other floristic treatments (Gillett 1963; Mulligan 1974; Ceska and Ceska 1988; Douglas 1982, 1995; Douglas et al. 1996; Straley et al. 1985) while most are known only from range descriptions in regional floras (e.g., Hitchcock et al. 1955-1969; Douglas et al. 1989-1991, 1994) or research papers (Douglas and Packer 1988; Henderson et al. 1990; Packer 1972, 1983; Soreng 1991). These endemic regions and their vascular plant components are as follows:

1. Queen Charlotte Islands-Northern Vancouver Island-Southeastern Alaska Region

This region includes endemic taxa associated with glacial refugia located on the Queen Charlotte

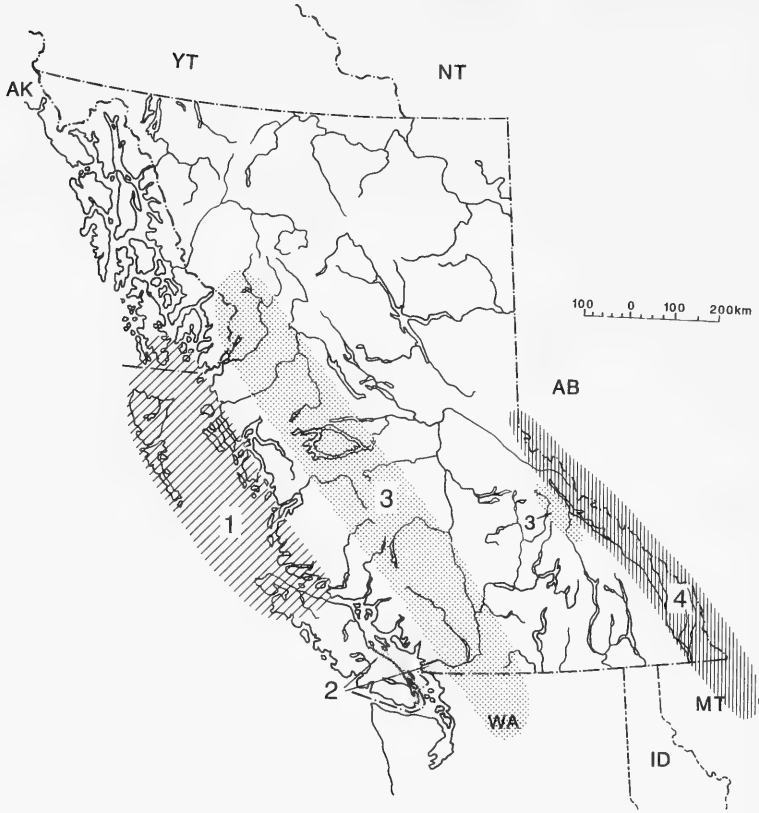


FIGURE 1. Endemic elements of British Columbia and immmediately adjacent regions. 1 - Queen Charlotte Islands-Northern Vancouver Island-Southeastern Alaska, 2 - Southern Vancouver Island-Lower Fraser Valley, 3 - Coast-Cascade Mountains-Selkirk Mountains, 4 - Rocky Mountains (Southern Canada-Northern U.S.).

Islands (Calder and Taylor 1968). These plants often have ranges which also extend to adjacent islands or the mainland (Figure 1). For instance, seven of the 10 plants in this region range south to northern Vancouver Island. These include Queen Charlotte Avens (*Geum schofieldii* Calder & Taylor*), Queen Charlotte Isopyrum (*Isopyrum savilei* Calder & Taylor*), Calder's Lovage (*Ligusticum calderi* Mathias & Const.*), Alp Lily (*Lloydia serotina* [L.] Richenb. ssp. *flava* Calder & Taylor*), Taylor's Saxifrage (*Saxifraga taylori* Calder & Savile*), Queen Charlotte Butterweed (*Senecio moresbiensis* [Calder & Taylor] G.W. Dougl. & G. Ruyle-Dougl.*) and Queen Charlotte Twinflower Violet (*Viola biflora* L. ssp. *carlottae* Calder & Taylor*). *Ligusticum calderi*, *Senecio moresbiensis*, and Glabrous Dwarf Willow (*Salix reticulata* L. ssp. *glabellicarpa* Argus*), also range north to southeastern Alaska. Cordate-leaved Saxifrage (*Saxifraga nelsoniana* D. Don ssp. *carlottae* [Calder & Savile] Hult.*) also occurs in the Coast Mountains on the adjacent mainland. Newcombe's Butterweed (*Senecio newcombei* Greene*) is the only species known to be restricted entirely to the Queen Charlotte Islands at this time.

2. Southern Vancouver Island-Lower Fraser River Valley Region

This region includes the remaining two (of nine) taxa which have their ranges entirely within British Columbia (Figure 1). Both species, Vancouver Island Beggarsticks (*Bidens amplissima* Greene*) and Macoun's Meadow-foam (*Limnanthes macounii* Trel.*), occur in recently glaciated areas thus indicating that at certain times during glaciation parts of the area must have been ice-free. *Bidens amplissima*

*Taxa marked with an asterisk are those currently being tracked by the British Columbia Conservation Data Centre.

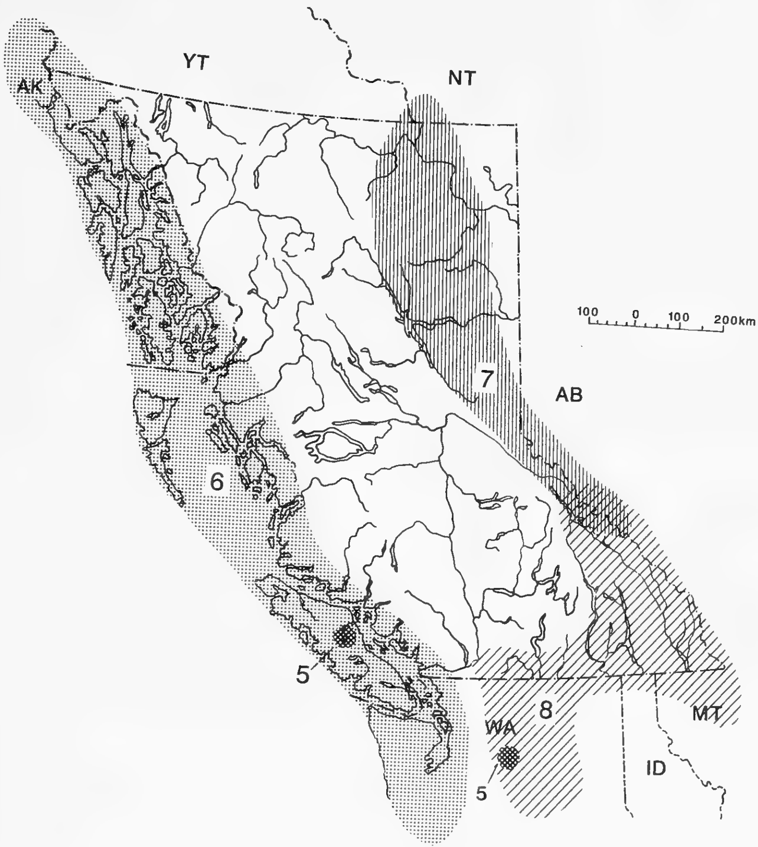


FIGURE 2. Endemic elements of British Columbia and immmediately adjacent regions. 5 - Vancouver Island Ranges-North Cascades, 6 - North Pacific Coast, 7 - Northern Rocky Mountains, 8 - Cascade Mountains-Rocky Mountains.

occurs on the southeast coast of Vancouver Island and in the lower Fraser River Valley. *Limnanthes macounii* ranges along the southeastern coast of Vancouver Island as well as on some of the adjacent islands.

3. Coast Mountains-North Cascade Mountains-Selkirk Mountains Region

This region ranges from the Coast Mountains of British Columbia (S of 57°N) to the North Cascade Mountains of southern British Columbia and northern Washington, and has a small outlier in the Selkirk Mountains of southeastern British Columbia (Figure 1). Lance-fruited Draba (*Draba lonchocarpa* Rydb. var. *thompsonii* [C.L. Hitchc.] Rollins*) is the only taxon within this region.

4. Rocky Mountain (Canada-Northern U.S.) Region

Plants in this region range south (from about 54°N) in the Rocky Mountains of Alberta and British Columbia to northern Idaho and/or northern Montana (Figure 1). Twelve taxa occur in this element. These species include Lake Louise Arnica (*Arnica louiseana* Farr*), Pink Agoseris (*Agoseris lackschewitzii* Henderson & Mosely*), Bourgeau's Milk-vetch (*Astragalus bourgovii* A. Gray*), Hooker's Thistle (*Cirsium hookeriana Nutt.*), Woolly Daisy (*Erigeron lanatus* Hook.*), Three-lobed Daisy (*E. trifidus* Hook.*), Sandberg's Desert-parsley (*Lomatium sandbergii* [Coult. & Rose] Coult. & Rose*), Dwarf Poppy (*Papaver alpinum* L.*), Oval Penstemon (*Penstemon ellipticus* Coult. & Fisch.), Lyall's Phacelia (*Phacelia lyallii* [A. Gray] Rydb.*), Banff Bluegrass (*Poa laxa* Haenke ssp. *banffianna* Soreng*) and High Alpine Butterweed (*Senecio conterminus* Greenm.*).

5. Vancouver Island Ranges-North Cascade Mountains Region

This region contains a single alpine species, Salish Daisy (*Erigeron salishii* G.W. Dougl. & Packer*). It occurs both in the central Vancouver Island Ranges

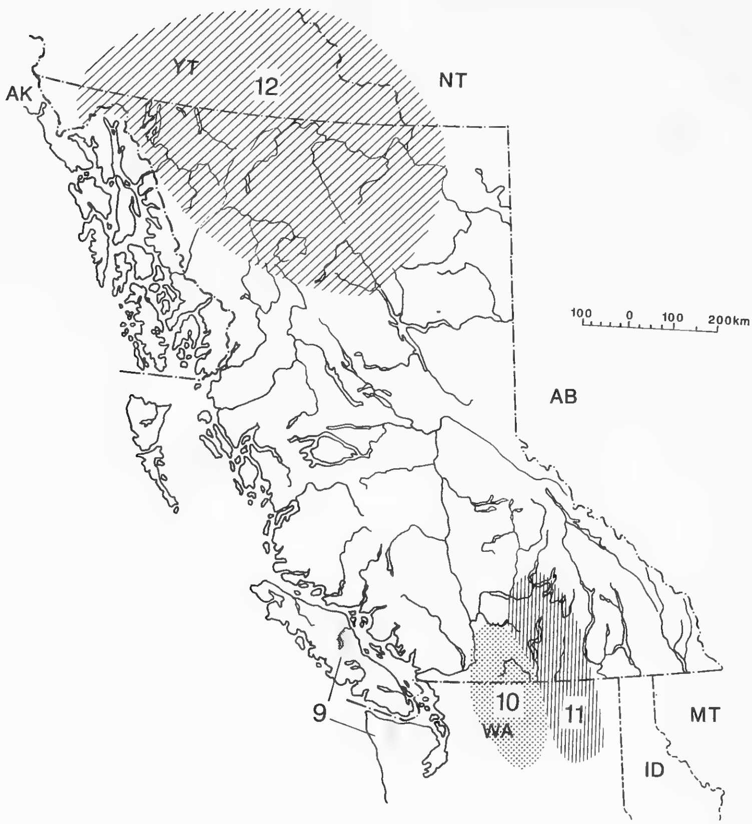


FIGURE 3. Endemic elements of British Columbia and immmediately adjacent regions. 9 - Vancouver Island Ranges-Olympic Mountains, 10 - North Cascade Mountains, 11 - Shuswap Highlands-Okanagan Valley-Columbia River Basin, 12 - Northern Mountains and Plateaus.

and the North Cascade Mountains of Washington (Figure 2).

6. North Pacific Coast Region

This region extends along the coast from Vancouver Island north to southeastern Alaska (Figure 2). The seven taxa in this region are likely associated with coastal glacial refugia since most of their range was glaciated. Taxa in this group are Fern-leaved Goldthread (*Coptis asplenifolia* Salisb.), Lance-fruited Draba (*Draba lonchocarpa* var. *vestita* O.E. Schulz*), Swamp Gentian (*Gentiana douglasiana* Bong.), Bird's-beak Lousewort (*Pedicularis ornithorhyncha* Benth.), Alaska Holly Fern (*Polystichum setigerum* [K. Presl] K. Presl.*), Cooley's Buttercup (*Ranunculus cooleyae* Vasey & Rose), Menzies' Burnet (*Sanguisorba menziesii* Rydb.*).

7. Northern Rocky Mountain Region

The taxa in this region range north (from about 52°N) in the Rocky Mountains of southern Alberta and British Columbia to southeastern Yukon and southwestern Northwest Territories (Figure 2). The three taxa in this group are Boreal Paintbrush (*Castilleja fulva* Pennell*), Jordal's Locoweed (*Oxytropis jordalii* Porsild ssp. *davisii* [Welsh] Elisens & Packer*) and Raup's Willow (*Salix raupii* Argus*). *Castilleja fulva* also has a single disjunct station in the southwestern Yukon.

8. Cascade Mountains-Rocky Mountains Regions

This region ranges from the Cascade Mountains of southern British Columbia and northern Washington to the Rocky Mountains of southern British Columbia, southern Alberta and northern Montana (Figure 2). Five taxa are included in this range: Timber Milk-vetch (*Astragalus miser* Dougl. vars. *miser* and *serotinus* [Gray *ex* Cooper] Barneby), Deer Paintbrush (*Castilleja cervina* Greenm.), Golden Fleabane (*Erigeron aureus* Greene) and Columbia River Locoweed (*Oxytropis columbiana* St. John.*).

9. Vancouver Island Ranges-Olympic Mountains Region

This endemic region occurs in the southern Vancouver Island Ranges and the Olympic Mountains of Washington (Figure 3). A single species, Olympic Mountain Aster (*Aster paucicapitatus* [B.L. Robins.] B.L. Robins.*), belongs to this element.

10. Southern Coast Mountains-North Cascade Mountains Region

This endemic region contains species which occur in the southern Coast Mountains and the Cascade Mountains of southwestern British Columbia and northern Washington (Figure 3). This group includes two taxa, Elmer's Paintbrush (*Castilleja elmeri* Fern.) and Elmer's Butterweed (*Senecio elmeri* Piper).

11. Shuswap Highland-Okanagan Valley-Columbia River Basin Region

This region ranges from the Shuswap Highlands of southcentral British Columbia through the Okanagan Valley to the northern Columbia River Basin of northern Washington (Figure 3). The single species in this region is Okanogan fameflower (*Talinum sediforme* Poelln.*).

12. Northern Mountains/Plateaus Region

A single species, Mount Sheldon Butterweed (*Senecio sheldonensis* Porsild*) occurs in this region. It ranges through most of northern British Columbia, southern Yukon and southwestern Northwest Territories (Figure 3).

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# *Catatropis lagunae* n. sp., Trematoda, Notocotylidae, parasite d'oiseaux de mer

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Bayssade-Dufour, Christiane, Jean-Louis Albaret, Hélène Fermet-Quinet, et Khémais Farhati. 1996. *Catatropis lagunae* n. sp., Trematoda, Notocotylidae, parasite d'oiseaux de mer. Canadian Field-Naturalist 110(3): 392–402.

Des cercaires émises par des Mollusques *Hydrobia ulvae* des côtes atlantiques de France, s'enkystent sur des algues *Ulva lactuca*; la consommation d'algues porteuses de métacercaires contamine en laboratoire de jeunes Oiseaux Anatidae *Anser anser*, *Anas platyrhynchos* et *Cairina moschata*. Les Mammifères *Mesocricetus auratus* et *Mus musculus* sont réfractaires. Les vers adultes obtenus dans les coecums digestifs des Oies et Canards ont les caractéristiques des Notocotylidae Lühe, 1909 et répondent à la définition du genre *Catatropis* Odhner, 1905. La poche du cirre très longue occupant la moitié antérieure du corps, la vésicule séminale externe très volumineuse et le cirre recouvert de tubercules caractérisent une espèce nouvelle appelée *Catatropis lagunae* dont la morphologie est complétée par des observations au microscope électronique à balayage. Les vers pondent des oeufs operculés à filaments polaires qui n' éclosent pas dans l'eau saumâtre. L'hôte vertébré naturel est inconnu mais pourrait être l' Anatidae migrateur *Branta bernicla bernicla*, présent en hiver sur le site et consommateur d'algues vertes marines ou saumâtres. Les cercaires mûres, monostomes, apharyngées, à nombreuses cellules kystogènes, à trois taches antérieures, à glandes adhésives postérieures, à pores excréteurs s'ouvrant dans le tiers antérieur de la queue, correspondent au type *monostomi* des Notocotylidae. Leur chétotaxie céphalique et caudale est décrite. L'intérêt des papilles ventrales des vers adultes est souligné, elles ont une action pathogène sur les hôtes.

Mots clés : *Catatropis lagunae*, Trematoda, Notocotylidae, morphologie, cycle biologique, chétotaxie, MEB, *Anser anser*, *Anas platyrhynchos*, *Cairina moschata*, *Hydrobia ulvae*.

L'aire étudiée est une lagune saumâtre, près de la côte orientale de l'île d'Oléron, à Boyardville (Charente-Maritime); elle est séparée de l'Océan Atlantique par un cordon littoral de sable et terre. Elle appartient à la Réserve Naturelle de l'île. Son fond est constitué de sable vaseux. Sa végétation comprend essentiellement des algues vertes *Ulva lactuca*, *Ulothrix* sp. et une algue bleue *Microcoleus chthonoplastes*. Elle est fréquentée, en automne et hiver par plusieurs milliers de Bernaches cravants *Branta bernicla bernicla*, de Tadornes de Belon *Tadorna tadorna*, Anatidae, d' Huîtriers-pies *Haematopus ostralegus*, Haematopodidae, par des Cormorans *Phalacrocorax* sp. Phalacrocoriacidae, des Hérons cendrés *Ardea cinerea* et des Aigrettes *Egretta garzetta*, Ardeidae, au total par plusieurs centaines de milliers d'oiseaux migrateurs, selon Mahéo (1991) et Walmsey (1991). Des Goélands argentés *Larus argentatus* et des Mouettes *L.* sp., Laridae, y sont également abondants toute l'année. Les Bernaches cravants stationnent fréquemment au bord de la lagune; elles peuvent également tenir leurs quartiers d'hiver sur d'autres côtes françaises, ainsi que sur les côtes néerlandaises et anglaises tandis qu'elles estivent en Sibérie Occidentale, dans la Péninsule de Taymyr, selon Cramp et al. (1977). La Bernache *Branta bernicla hrota* venant du Canada et du Groenland n'a pas été signalée à Oléron mais sur les côtes de Normandie. Toutefois depuis la création récente de la Réserve, un nombre croissant d'espèces migratrices est attiré dans l'île. Les vertébrés aquatiques de la lagune sont de jeunes poissons, et les invertébrés, de très nombreux Mollusques Prosobranches ainsi que des arthropodes et des isopodes.

Le but de ce travail est de connaître les Trématodes parasites des espèces animales protégées en partant des stades larvaires: les cercaires, émises par des Mollusques naturellement infestés et en réalisant le cycle biologique, en laboratoire, sur des modèles expérimentaux.

## Matériel et méthodes.

Des Mollusques Hydrobiidae *Hydrobia ulvae* (Pennant, 1777) naturellement infestés, sont récoltés, dans la lagune, au mois de décembre; après exposition à la lumière, ils émettent des cercaires dont plusieurs sont dessinées vivantes à la chambre claire, d'autres étant imprégnées au nitrate d'argent selon la méthode de Combes et al. (1976), pour la mise en évidence de leurs récepteurs sensoriels ou sensilles. La majorité d'entre elles s'enkyste, moins d'une heure après l' émission, sur *Ulva lactuca*. Quelques

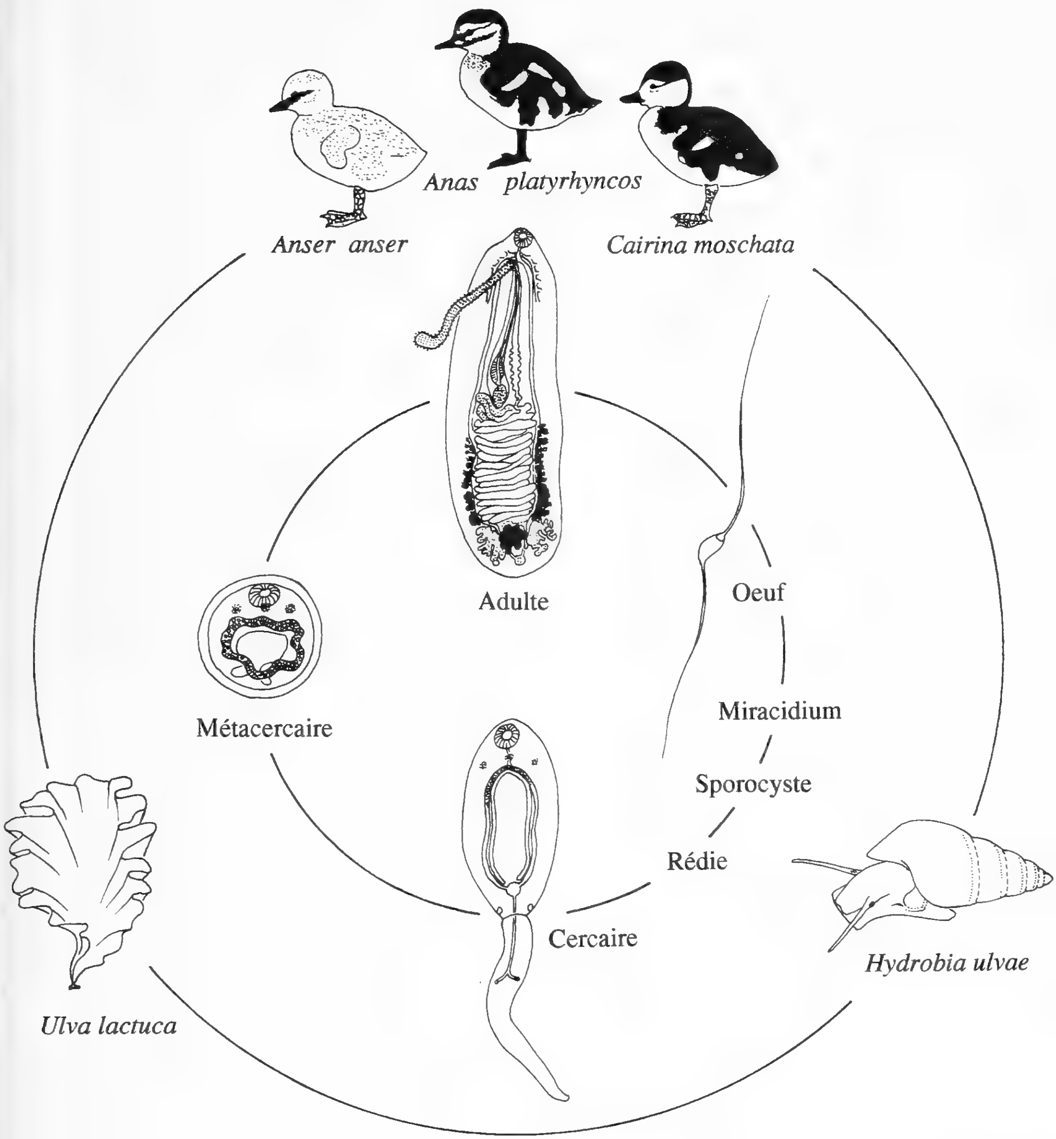


FIGURE 1. Cycle biologique de *Catatropis lagunae* n. sp.

métacercaires sont dessinées vivantes; les autres, fixées sur des algues, sont données en nourriture à un Canard de Barbarie *Cairina moschata* 77 TM, deux Oies cendrées *Anser anser* 76 TM et 72 TM, un Canard colvert *Anas platyrhynchos* 78 TM, chacun âgé de quelques jours et élevé à l'abri de contaminations parasitaires, ainsi qu'à un Hamster *Mesocricetus auratus* et quatre Souris *Mus musculus*. *C. moschata* consomme à J zéro, 80 métacercaires, puis à J + 2, 30 métacercaires; il est autopsié 11 jours après la première infestation. *A. anser* 76 TM consomme à J zéro, 100 métacercaires, puis à J +13, 200 métacercaires; son sacrifice a lieu 24 jours après la première infestation. *A. anser* 72 TM ingère 100 métacercaires et est autopsié à J + 27. *A. platyrhynchos* reçoit, à J zéro, 150 métacercaires puis à J +1, 100 métacercaires; il est autopsié 15 jours après la première infestation. Chez les quatre Anatidae, des vers adultes sont recueillis. Quelques uns, mis dans du sérum physiologique ou dans de l'eau de mer, pondent. Les autres sont fixés à l'alcool, au formol à 10%, ou à la glutaraldéhyde,

certains étant aplatis entre lame et lamelle. Une partie des vers de 77 TM, 76 TM et 72 TM est colorée au Carmin chlorhydrique alcoolique, dessinée et mesurée à la chambre claire; une partie des vers de 77 TM, 76 TM et 78 TM est déshydratée à l'alcool, passée au point critique au CO2, métallisée à l'Or-Palladium et observée au microscope électronique à balayage JEOL 840 A. Le Hamster et les quatre Souris ayant ingéré des métacercaires sont sacrifiés, *M. auratus* à J + 21, *M. musculus*, respectivement à J + 5, +15, + 21 et + 21.

## Résultats

Un total de 82 Trématodes adultes, appartenant manifestement à la même espèce, est recueilli dans les coecums digestifs des Anatidae: 10 chez *C. moschata*, 45 chez *A. anser* 76 TM, 7 chez *A. anser* 72 TM et 20 chez *A. platyrhynchos*. *Mauratus* et *M. musculus* n'hébergent aucun parasite.

**Cycle biologique du Trématode.**

Le cycle biologique (figure 1) admet deux hôtes successifs.

Le premier hôte naturel est le Mollusque marin ou saumâtre *Hydrobia ulvae*. Cette espèce, dont plusieurs milliers de représentants ont été récoltés à Oléron, a produit des cercaires pendant plus de deux mois; celles-ci, émises à la lumière, s'enkystent essentiellement sur les algues *Ulva lactuca*; les métacercaires sont infestantes quelques heures à quelques jours après l'enkystement.

Rothschild (1938) et Deblock (1980) signalent la présence de cercaires, issues de rédies, de genre indéterminé et de morphologie identique à celle de notre cercaire chez les *Hydrobia* des côtes anglaises et françaises de la Manche; le cycle biologique s'y réalise donc. Il est possible qu'il se déroule aussi dans d'autres pays et continents puisque, selon Scarlato ( 1987), *H. ulvae* est présent des côtes du Maroc à celles de la Mer Blanche (Sibérie Occidentale, Russie). *H. ulvae* n'existe pas sur les côtes atlantiques américaines, mais l'espèce proche, *H. totteni* Morrison, 1954, est présente, du Labrador au New Jersey, selon Abott (1974).

Les hôtes définitifs expérimentaux sont *C. moschata*, *A. anser* et *A. platyrhynchos*. Les vers deviennent adultes et ovigères en 9 jours environ. Les hôtes définitifs naturels du parasite sont inconnus. Les seuls Oiseaux consommateurs d'algues vertes marines ou saumâtres sont les Bernaches cravants, selon Cramp et al. (1977) ; elles peuvent donc s'infester comme nos modèles, par ingestion de métacercaires enkystées sur *U. lactuca*. *Branta bernicla bernicla,* présente à Oléron, pourrait être l'hôte naturel du parasite.

Les oeufs des vers sont éliminés avec les déjections des Anatidae expérimentalement infestés; laissés seuls, dans l'eau de mer ou saumâtre, ces oeufs n'évoluent pas mais y demeurent pendant plusieurs semaines; laissés avec des *Hydrobia* vivants, ils disparaissent, en quelques jours, probablement consommés par les Mollusques. Les oeufs de la plupart des familles de Trématodes éclosent dans l'eau, après maturation; parmi les exceptions, Wright et Bennet (1964) signalent ceux de Notocotylidae qui éclosent dans le tube digestif des Mollusques qui les consomment et deviennent ainsi infestants pour leurs premiers hôtes. Ces oeufs, contrairement au cas très général, contiennent un sporocyste et non un miracidium, selon Murrils et al. (1985).

**Description du Trématode**

**Les vers adultes.** Les dimensions du corps et celles des principaux organes de 19 spécimens sont données dans le tableau 1. Les vers 77 TM ont entre 9 et 11 jours, ils sont les plus jeunes; ils sont déjà ovigères. Les vers 72 TM ont 27 jours, ils sont les plus âgés. Les vers 76 TM sont séparables en deux lots: les plus longs, vraisemblablement âgés de 24 jours et les plus courts, âgés de 11 jours. Les vers longs de 76 TM et tous ceux de 72 TM ( âgés de 24 et 27 jours) ont des tailles significativement supérieures à celles des vers courts de 76 TM et à celles de 77 TM, âgés de 9 à 11 jours. Ceci indique que les parasites continuent à grandir après leur maturité sexuelle et qu'une première infestation n' empêche pas la réussite d'une seconde. Le métraterme, la poche du cirre et l'espace occupé par les vitellogènes sont plus longs chez les vers âgés que chez les jeunes; par contre, le nombre de papilles ventrales, la taille de l'ovaire, des testicules et de la ventouse orale ne semblent pas varier ou varient très peu avec l'âge.

Le corps des adultes (figure 2, 3) est allongé, à bords parallèles, à concavité ventrale, il est pourvu d'une cuticule à épines larges dans la région antérieure, fines dans la région postérieure et à mélange d'épines larges et fines dans une zone de transition. Le tégument porte, ventralement, dans la région médiane de la moitié postérieure du corps, une crête longitudinale, rouge clair sur le ver vivant, bordée à gauche et à droite de 6 à 9 papilles, approximativement symétriques. La ventouse orale est terminale et de diamètre relativement faible. L'appareil digestif comporte une bouche, un oesophage court, des coecums modérément sinueux et très longs, passant entre les glandes vitellogènes et l'utérus, puis entre les testicules et l'ovaire et se terminant au voisinage du pore excréteur. L'appareil génital mâle comprend, dans la région postérieure du corps, deux testicules symétriques, latéraux, profondément lobés sur leur bord externe, deux canaux déférents confluant rapidement en un canal médian unique, une volumineuse vésicule séminale externe repliée plusieurs fois sur elle- même, une poche du cirre très longue atteignant la moitié du corps et comprenant une

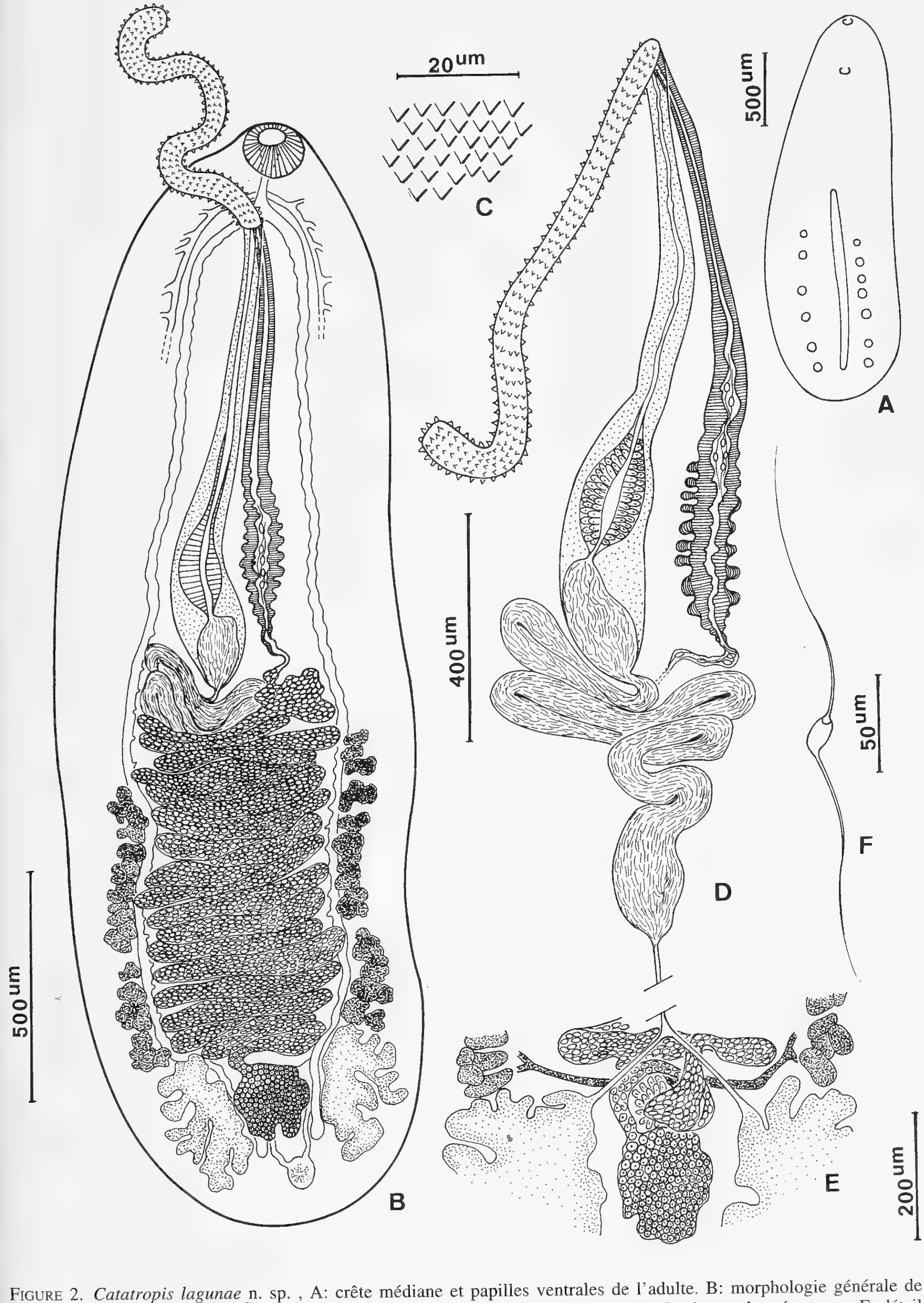


FIGURE 2. *Catatropis lagunae* n. sp. , A: crête médiane et papilles ventrales de l'adulte. B: morphologie générale de l'adulte. C: détail des épines au niveau du pore excréteur. D: détail de la poche du cirre et du métraterme. E: détail du carrefour génital. F: oeuf du métraterme.

TABLEAU 1. *Catatropis lagunae* n. sp. Dimensions en millimètres du corps et des principaux organes de 19 spécimens adultes, d'âges différents.

| **Hotes et Vers** | Age des Vers | Long × larg. | Ventouse | Testicule G. | Testicule D. | Vitellus G. | Vitellus D. | Poche du cirre: L | Métraterme | Ovaire |
|---|---|---|---|---|---|---|---|---|---|---|
| ***C. moschata 77 TM*** | | | | | | | | | | |
| 77 TM 1 | 9-11 jours | 1.48 × 0.59 | 0.16 | 0.28 × 0.12 | 0.27 × 0.12 | 0.23 × 0.08 | 0.23 × 0.08 | 0.63 | 0.55 × 0.07 | 0.13 × 0.10 |
| 77 TM 5 | 9-11 jours | 1.48 × 0.52 | 0.15 | 0.27 × 0.10 | 0.24 × 0.12 | 0.20 × 0.08 | 0.20 × 0.08 | 0.60 | 0.55 × 0.08 | 0.14 × 0.11 |
| 77 TM 4 | 9-11 jours | 1.60 × 0.57 | 0.16 | 0.31 × 0.15 | 0.31 × 0.17 | 0.28 × 0.08 | 0.27 × 0.08 | 0.66 | 0.59 × 0.09 | 0.14 × 0.12 |
| 77 TM 3 | 9-11 jours | 1.65 × 0.59 | 0.14 | 0.26 × 0.11 | 0.28 × 0.12 | 0.31 × 0.08 | 0.25 × 0.06 | 0.72 | 0.65 × 0.06 | 0.15 × 0.11 |
| 77 TM 2 | 9-11 jours | 1.69 × 0.60 | 0.14 | 0.28 × 0.12 | 0.30 × 0.14 | 0.28 × 0.08 | 0.23 × 0.08 | 0.70 | 0.60 × 0.06 | 0.13 × 0.10 |
| **moyenne** | | **1.58 × 0.57** | **0.15** | **0.28 × 0.12** | **0.28 × 0.13** | **0.26 × 0.08** | **0.24 × 0.08** | **0.66** | **0.59 × 0.07** | **0.14 × 0.11** |
| ***A. anser 76 TM*** | | | | | | | | | | |
| 76 TM 19 | 11 jours | 1.65 × 0.64 | 0.12 | 0.23 × 0.18 | 0.24 × 0.15 | 0.32 × 0.06 | 0.39 × 0.06 | 0.80 | 0.62 × 0.09 | 0.19 × 0.12 |
| 76 TM 24 | 11 jours | 1.84 × 0.84 | 0.12 | 0.29 × 0.17 | 0.29 × 0.20 | 0.53 × 0.05 | 0.34 × 0.05 | 0.72 | 0.61 × 0.07 | 0.17 × 0.12 |
| 76 TM 20 | 11 jours | 1.88 × 0.68 | 0.12 | 0.30 × 0.17 | 0.21 × 0.16 | 0.43 × 0.06 | 0.48 × 0.05 | 0.88 | 0.62 × 0.10 | 0.18 × 0.12 |
| **moyenne** | | **1.79 × 0.65** | **0.12** | **0.27 × 0.17** | **0.25 × 0.17** | **0.43 × 0.06** | **0.40 × 0.05** | **0.80** | **0.62 × 0.09** | **0.18 × 0.12** |
| 76 TM 10 | 24 jours | 2.10 × 0.88 | 0.13 | 0.33 × 0.21 | 0.34 × 0.18 | 0.67 × 0.08 | 0.51 × 0.07 | 0.93 | 0.60 × 0.09 | 0.18 × 0.13 |
| 76 TM 6 | 24 jours | 2.03 × 0.77 | 0.13 | 0.34 × 0.22 | 0.29 × 0.12 | 0.60 × 0.07 | 0.60 × 0.06 | 0.93 | 0.78 × 0.09 | 0.18 × 0.16 |
| 76 TM 7 | 24 jours | 2.03 × 0.91 | 0.15 | 0.39 × 0.25 | 0.34 × 0.26 | 0.59 × 0.05 | 0.57 × 0.06 | 0.93 | 0.67 × 0.09 | 0.19 × 0.15 |
| 76 TM 21 | 24 jours | 2.40 × 0.68 | 0.12 | 0.36 × 0.18 | 0.36 × 0.17 | 0.42 × 0.03 | 0.54 × 0.06 | 1.07 | 0.71 × 0.07 | 0.16 × 0.09 |
| 76 TM 8 | 24 jours | 2.70 × 0.97 | 0.16 | 0.38 × 0.25 | 0.42 × 0.23 | 0.68 × 0.08 | 0.68 × 0.09 | 1.07 | 0.90 × 0.10 | 0.21 × 0.18 |
| 76 TM 18 | 24 jours | 2.90 × 0.82 | 0.15 | 0.37 × 0.25 | 0.40 × 0.26 | 0.77 × 0.11 | 0.67 × 0.11 | 1.17 | 0.85 × 0.08 | 0.17 × 0.14 |
| **moyenne** | | **2.45 × 0.84** | **0.14** | **0.36 × 0.23** | **0.36 × 0.20** | **0.62 × 0.07** | **0.60 × 0.08** | **1.02** | **0.75 × 0.09** | **0.18 × 0.14** |
| ***A. anser 72 TM*** | | | | | | | | | | |
| 72 TM 1 | 27 jours | 2.40 × 0.73 | 0.12 | 0.34 × 0.15 | 0.33 × 0.18 | 0.60 × 0.10 | 0.62 × 0.09 | 1.02 | 0.88 × 0.10 | 0.12 × 0.13 |
| 72 TM 3 | 27 jours | 2.60 × 0.83 | 0.14 | 0.34 × 0.17 | 0.35 × 0.20 | 0.60 × 0.08 | 0.64 × 0.07 | 1.09 | 0.94 × 0.09 | 0.18 × 0.16 |
| 72 TM 4 | 27 jours | 2.75 × 0.95 | 0.14 | 0.39 × 0.20 | 0.35 × 0.18 | 0.55 × 0.10 | 0.53 × 0.10 | 1.25 | 0.86 × 0.09 | 0.18 × 0.16 |
| 72 TM 2 | 27 jours | 2.90 × 0.90 | 0.11 | 0.33 × 0.17 | 0.38 × 0.22 | 0.68 × 0.09 | 0.65 × 0.07 | 1.14 | 1.02 × 0.09 | 0.19 × 0.20 |
| 72 TM 5 | 27 jours | 2.90 × 0.92 | 0.14 | 0.45 × 0.18 | 0.34 × 0.15 | 0.79 × 0.10 | 0.66 × 0.10 | 1.24 | 0.91 × 0.09 | 0.19 × 0.10 |
| **moyenne** | | **2.71 × 0.87** | **0.13** | **0.37 × 0.17** | **0.35 × 0.19** | **0.64 × 0.09** | **0.62 × 0.09** | **1.15** | **0.92 × 0.09** | **0.17 × 0.15** |

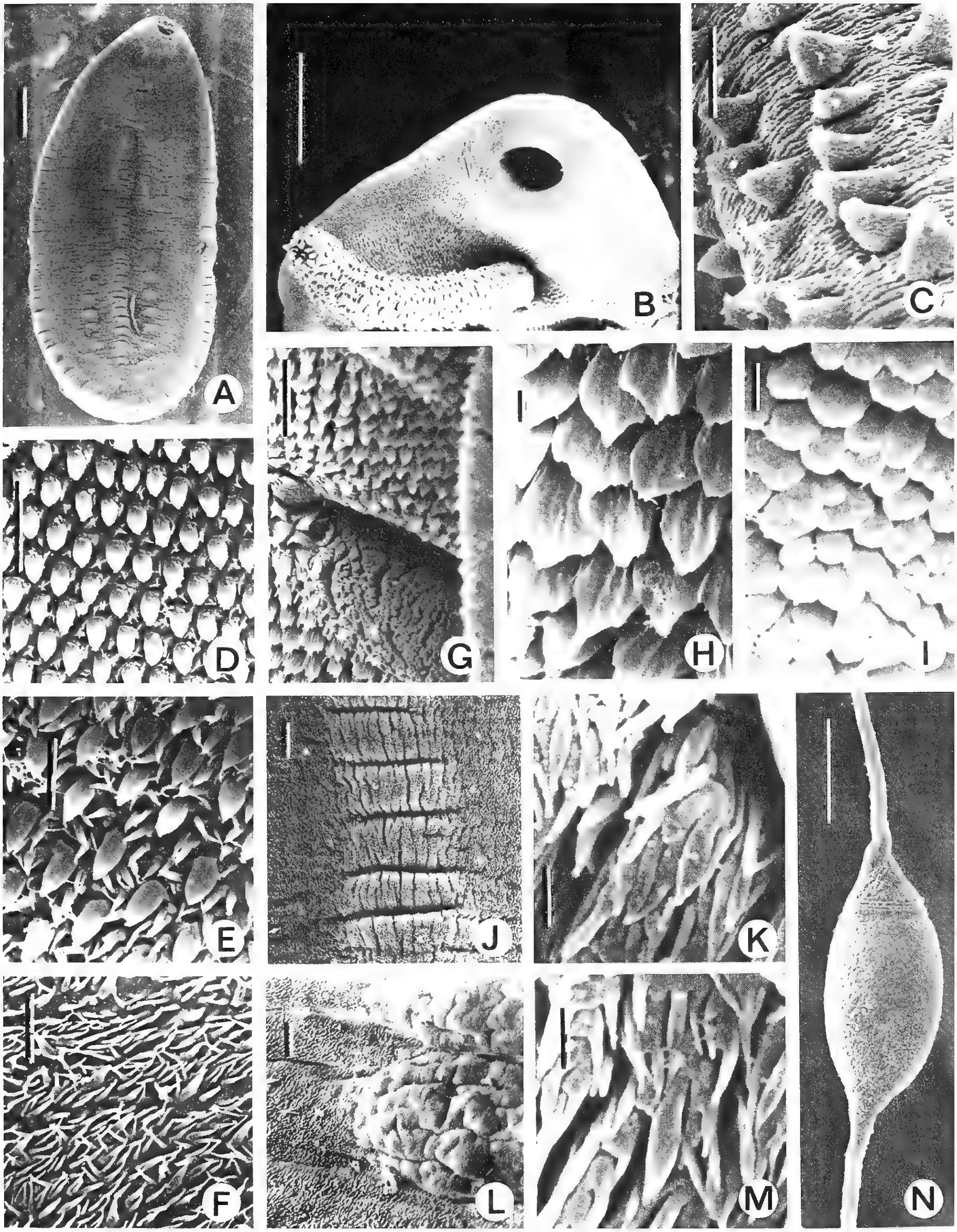


FIGURE 3. *Catatropis lagunae* n. sp. M.E.B., A: ver adulte, vue ventrale. B: ventouse orale et cirre. C: détail des tubercules du cirre. D: épines antéro–ventrales. E: épines médio–ventrales. F: épines postéro–ventrales. G: pore génital. H et I: détail des formations bordant le pore génital. J: crête médiane. K: détail de la crête médiane. L: papille ventrale. M: détail d'une papille ventrale. N: oeuf.
Barres A, B =100 µm. C, D, G, J, L, N = 10 µm. E, F = 5 µm. H, I, K, M =1 µm

vésicule séminale interne, une *pars prostatica* entourée de cellules prostatiques, un canal éjaculateur et un long cirre évaginable entièrement couvert de tubercules d'environ 6 à 9 µm de hauteur. Le pore génital médian est unique et s'ouvre, le plus fréquemment, avant la bifurcation coecale, plus rarement en arrière de celle-ci. L'appareil génital femelle comprend un ovaire médian légèrement lobé, intertesticulaire et intercoecal, un court oviducte, un ootype antérieur à l'ovaire, un utérus formant 12 à 20 boucles, le plus souvent 16 à 18, transversales, ascendantes, qui se termine par un métraterme allongé, rectiligne, à paroi très musculeuse, situé à gauche de la poche du cirre, parallèle à celle-ci mais plus court. Les glandes vitellogènes s'étendent latéralement depuis le bord antérieur des testicules jusqu'au niveau des avant-dernières anses utérines; elles déversent leur contenu dans deux fins vitelloductes transverses. Il n'y a pas de réceptacle séminal. L'appareil excréteur comprend une petite vessie à paroi fine, deux canaux longitudinaux côtoyant le bord externe des coecums digestifs, remontant jusqu'au niveau de l'oesophage où ils se réunissent pour former une boucle antérieure; le pore excréteur est postéro-dorsal.

**Les oeufs.** Les oeufs pondus, ovoïdes et operculés, (figure 2F, 3N) mesurent environ 20 x 10 µm. A chaque extrémité, ils portent un filament long d'environ 200 µm. Ceux de la première boucle utérine sont sans filament, ceux des boucles suivantes ont des filaments d'abord courts puis plus longs. Ceux du métraterme ont des filaments de taille comparable à celle des oeufs pondus; aucun miracidium n'est observé. Le sporocyste et la rédie n'ont pas été examinés.

**Les cercaires.** Le corps des cercaires émises par le Mollusque (figure 4A) mesure, selon l' état de contraction ou d'allongement, 350 à 550 µm de long x 110 à 250 µm de large et la queue 400 à 600 µm de long x 50 µm à l'endroit le plus large; la région céphalique et la queue sont claires. Le corps, rempli de cellules kystogènes brun sombre, est opaque. La région céphalique porte une petite ventouse orale, terminale, globuleuse, d'environ 30 µm de diamètre, à l'arrière de laquelle s'observent deux ocelles sombres, dorso-latéraux et une tache médio-dorsale. L'appareil digestif comprend une bouche, un oesophage et deux longs coecums atteignant l'extrémité postérieure du corps. Le système excréteur présente une vessie arrondie à paroi fine, des canaux remplis de granulations, formant une anse antérieure non diverticulée au niveau de l'oesophage, postérieure aux trois taches sombres. Le canal excréteur caudal parcourt le tiers antérieur de la queue puis bifurque et déverse ses produits par deux pores latéraux. Les cellules-flammes n'ont pas été observées. L'extrémité postérieure du corps porte deux organes adhésifs latéraux symétriques. Le corps et la queue sont pourvus d'une puissante musculature. La cercaire nouvellement émise, nage pendant plusieurs dizaines de minutes dans l'eau saumâtre puis s'enkyste sur une surface solide: thalle d'algue ou paroi du récipient d'élevage.

La chétotaxie de la cercaire (figure 4B-E) montre environ 150 récepteurs sensoriels céphaliques, répartis sur trois cycles. Le cycle $C_I$ a 7 sensilles invaginées à l'intérieur de la bouche; le cycle $C_{II}$, 39 à 42 sensilles; le cycle $C_{III}$, 100 à 106 sensilles, soit, de part et d'autres du plan de symétrie bilatérale: (3) + (12 à 15) + (10 à 11) + (16) + (9 à 10) sensilles. La queue porte 8 récepteurs dont 2 dorsaux UD, 2 dorso-latéraux UDL1 au niveau des pores excréteurs et 4 dorso-latéraux UDL2 et UDL3 en région terminale. La chétotaxie corporelle n'a pas été analysée.

**Les métacercaires.** Elles ont un kyste plan-convexe, mesurant environ 200 µm de diamètre et une coque d' environ 20 µm d' épaisseur; leur corps (figure 4F) est plus clair que celui de la cercaire, probablement suite à l' utilisation des cellules kystogènes; au début de l'enkystement, les trois taches antérieures sont visibles mais elles disparaissent en quelques jours; les granulations des canaux excréteurs demeurent longtemps apparentes et mobiles. Vu le faible pourcentage de transformation en adultes, le pouvoir infestant des métacercaires varie certainement avec l' âge.

**Détermination du Trématode**

Les oeufs pondus sont dotés de filaments polaires; les cercaires sont pourvues de trois taches antérieures sombres, dépourvues de glandes de pénétration; les cercaires, métacercaires et adultes sont monostomes et apharyngés; les adultes portent des papilles ventrales, ils ont des testicules symétriques près de l'extrémité postérieure du corps, une poche du cirre bien développée, un ovaire médian intertesticulaire et un utérus intercoecal. Ces caractères sont ceux de la famille Notocotylidae Lühe, 1909.

Dans cette famille, le genre *Catatropis* Odhner, 1905, est caractérisé par la présence, à la face ventrale du ver adulte, d'une crête longitudinale médiane et, de part et d'autre de celle-ci, d'une rangée de papilles distinctes. L'espèce que nous décrivons répond exactement, à cette définition.

Il n'en est pas de même pour six espèces, décrites sous ce nom de genre mais dont les vers adultes ne correspondent pas à l'exacte définition de *Catatropis* Odhner: *C. filamentis* Barker, 1915, *C. hisikui* Yamaguti, 1939, et *C. pacifera* Noble, 1933, sont dépourvus de crête médiane et ont trois rangées de papilles ventrales; *C. gallinulae* Johnston, 1928, n'a pas de crête médiane et a deux rangées de papilles ventrales; *C. johnstoni* Martin, 1956, et *C. nicolli* Cribb, 1991, sont pourvus d' une crête médiane mais sans papille ventrale. Ces espèces ainsi que *C.*

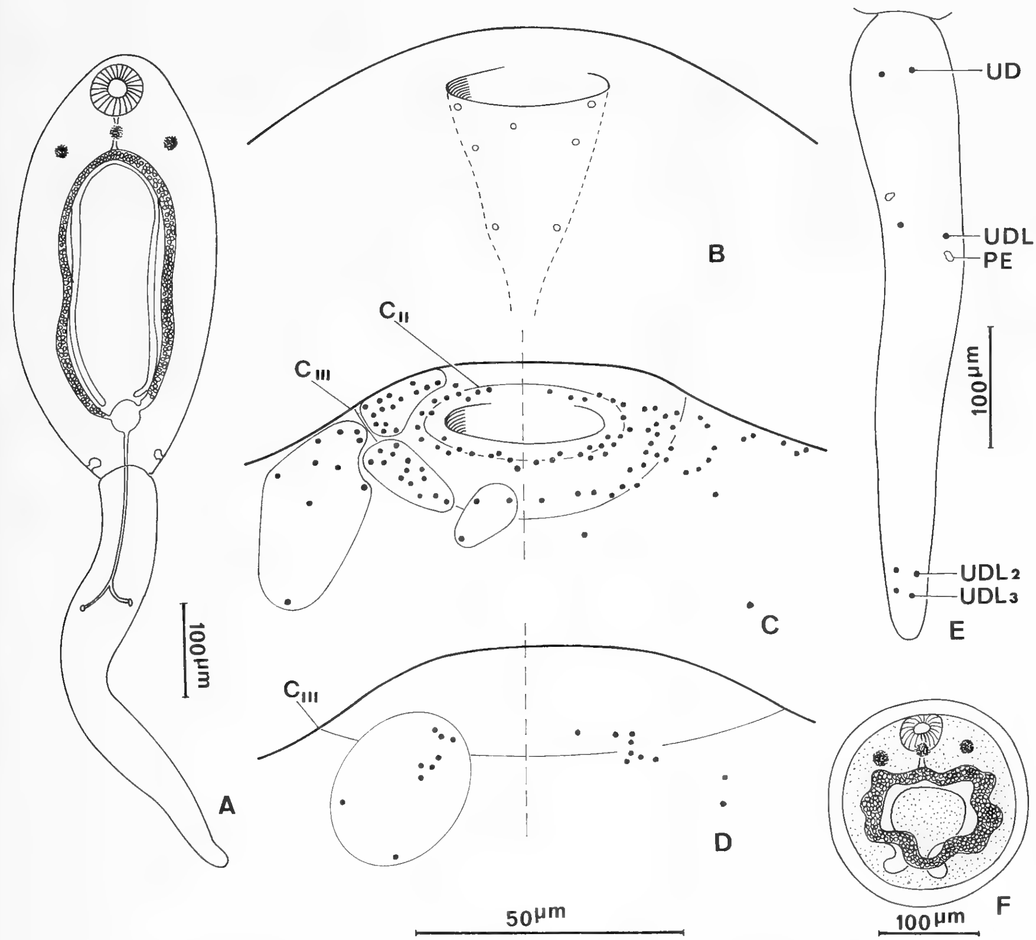


FIGURE 4. *Catàtropis lagunae* n. sp., A: cercaire mûre. B: sensilles du premier cycle céphalique. C: sensilles des deuxième et troisième cycles céphaliques, vue ventrale. D: sensilles du troisième cycle céphalique, vue dorsale. E: sensilles caudales. F: métacercaire.

*appendiculata* Lutz, 1928, non illustrée et trop brièvement décrite, sont exclues de la comparaison avec la nôtre.

Le cycle décrit dans ce travail admet le Mollusque marin *H. ulvae* pour premier hôte; quatre espèces de *Catatropis* ayant des Mollusques d'eau douce pour premiers hôtes sont donc également exclues de la comparaison; par ailleurs, la morphologie de leurs adultes est, elle aussi, différente; il s'agit de *C. verrucosa* (Froelich, 1789) parasite de *Melania tuberculata* selon Looss (1896), *C. indica* Srivastava, 1935 parasite de *Bithynia* sp. selon Rohde et Lee (1967), *C. joyeuxi* Dvoryadkin, 1987 parasite d'*Helicorbis sujfunensis* selon Dvoryadkin (1989) et *C. morosovi* Gubanov et al., 1966 parasite de *Bithynia contortrix* selon Dvoryadkin (1989).

Donc, sur les 21 espèces de *Catatropis* décrites, la comparaison effective porte sur les 10 suivantes: *C. charadrii* Skrjabin, 1915, *C. chinensis* Lai et al. 1984, *C. cygni* Yamaguti, 1939, *C. harwoodi* Bullock, 1952, *C. liara* Kossack, 1911, *C. misrai* Gupta et Singh, 1984, *C. orientalis* Harshe, 1932, *C. poecylorhynchai* (nouveau nom donné par Gupta et Sing, 1984 pour *C. rauschi* Gupta et Jehan, 1977, pré-employé), *C. pricei* Harwood, 1939, *C. rauschi* Singh, 1956.

Chez *C. liara*, la partie postérieure de la poche du cirre dépasse nettement la moitié du corps; chez *C. pricei*, elle ne l'atteint pas; chez *C. charadrii*, *C. cygni* et *C. poecylorhynchai*, elle a pour limite le tiers antérieur du corps et le quart chez *C. chinensis*, *C. harwoodi*, *C. misrai*, *C. orientalis* et *C. rauschi*. Chez notre espèce, elle se situe au niveau de la moitié du corps, et diffère de *C. liara*, *C. charadrii*,

*C. cygni*, *C. poecylorhynchai*, *C. chinensis*, *C. harwoodi*, *C. misrai*, *C. orientalis* et *C. rauschi*.

Outre la crête médiane, *C. poecylorhynchai* a 4 à 6 glandes ventrales par hémicorps, *C. harwoodi* et *C. orientalis* en ont respectivement 7 à 9 et 7 à 8. *C. rauschi* en a 10, *C. pricei* en a 10 à 11, *C. chinensis*, *C. liara* et *C. misrai* en ont 12, *C. cygni*, 12 à 18. Notre espèce a une crête médiane et 6 à 9 papilles ventrales, par hémicorps. Elle diffère de *C. rauschi*, *C. pricei*, *C. chinensis*, *C. liara*, *C. misrai* et *C. cygni*.

Chez *C. liara*, les vitellogènes n'atteignent pas le quart postérieur du corps; chez *C. orientalis*, ils atteignent le tiers postérieur; chez les huit autres espèces, leur limite est voisine de la moitié du corps. Chez notre espèce, elle n'atteint pas tout à fait la moitié du corps et diffère donc nettement de *C. liara* et *C. orientalis*.

Chez *C. cygni*, le métraterme est court, environ le tiers de la longueur de la poche du cirre; il a même longueur que la poche du cirre chez *C. charadrii* et *C. chinensis*; il est plus long chez *C. harwoodi*, *C. poecylorhynchai* et *C. rauschi*. Chez notre espèce, sa longueur représente environ les 4/5 de celle de la poche du cirre et se distingue de *C. cygni*, *C. charadrii*, *C. chinensis*, *C. harwoodi*, *C. poecylorhynchai* et, *C. rauschi*.

Chez *C. harwoodi* , les testicules sont lobés sur la totalité de leur pourtour, chez *C. pricei*, ils ne sont pas lobés, chez *C. liara* ils le sont légèrement; chez les sept autres espèces, ils sont lobés sur leur bord externe. Notre espèce a des testicules fortement lobés sur le bord externe, ce qui la différencie de *C. harwoodi* , *C . pricei*, et *C. liara*.

Au terme de la comparaison, elle paraît nouvelle et nous la désignons sous le nom de *Catatropis lagunae*.

**Diagnose de *Catatropis lagunae* n. sp.** Les types de *Catatropis lagunae* n. sp. sont déposés au Muséum National d'Histoire Naturelle de Paris sous les numéros 72 TM, 76 TM, 77 TM, 78 TM. La localité-type est l' île d'Oléron.

Les vers adultes sont parasites des coecums digestifs d'*Anser anser, Anas platyrhynchos, Cairina moschata*, hôtes expérimentaux. Modérément aplatis, ces vers mesurent 1, 48 à 2, 90 mm de long x 0, 52 à 0, 92 mm de large.

La combinaison des caractères suivants permet de définir l'espèce nouvelle du genre *Catatropis*: 6 à 9 papilles ventrales de part et d'autre de la crête médiane, poche du cirre très longue atteignant la moitié du corps, cirre couvert de forts tubercules, vésicule séminale externe très volumineuse, métraterme légèrement plus court que la poche du cirre et à paroi musculaire épaisse, testicules très lobés sur leur bord externe.

Les cercaires, émises par le Mollusque *Hydrobia ulvae*, sont semblables à *Cercaria Notocotylidae* sp. n° 10, Deblock, 1980, type *monostomi* Rothschild, 1938. Leur chétotaxie montre environ 150 sensilles céphaliques dont une quarantaine de C $_{II}$, une centaine de C $_{III}$ et 8 sensilles caudales dont 2 dorsolatérales au niveau des pores excréteurs et 4 dorsolatérales en région terminale.

## Discussion

*C. lagunae* serait un parasite naturel de la Bernache cravant selon l'hypothèse formulée ci-dessus. *Catatropis pricei* et *C. harwoodi* ont été décrits chez la Bernache du Canada *B. canadensis* respectivement par Harwood (1939) et Bullock (1952). Dans le second cas, l'Oiseau qui hébergeait 1700 vers dont 1000 *Catatropis*, a été trouvé mort. Les Notocotylidae parasitent également d'autres genres d'Anatidae et Rallidae. La connaissance de ces Trématodes est importante dans la perspective d'une protection efficace de la faune dont celle des Oiseaux migrateurs.

**La systématique des Notocotyles.** La systématique de ce groupe est controversée, de longue date. Leur originalité morphologique a conduit à les isoler dans le sous-ordre des Notocotylata Skrjabin et Schulz, 1933, réorganisé par Groschaft et Tenora (1981). Leur cycle avec enkystement en milieu extérieur, a incité La Rue (1957) à les apparenter aux Paramphistomoidea Stiles et Goldberger, 1910 (parasites notamment de Bovidae), dans le sous-ordre des Paramphistomata Szidat. Mais la comparaison du système sensoriel cercarien des Notocotyloidea et Paramphistomoidea, a mis en évidence des différences importantes: les Notocotylinae ont 30 à 40 sensilles céphaliques $C_{II}$, les Paramphistominae, environ 10; les premiers sont dépourvus de sensille acétabulaire S, les seconds en sont toujours pourvus, *Notocotylus* spp. portent plusieurs centaines de sensilles corporelles, *Paramphistomum* spp., quelques dizaines, selon Kanev et al. (1985) Samnaliev et al. (1986). Les Notocotyles dont *Catatropis*, passent pour archaïques du fait de leur cycle à deux hôtes (et non trois). Or l' appareil sensoriel des Trématodes primitifs se caractérise par un petit nombre de sensilles céphaliques et corporelles présentant une symétrie hexaradiée, selon Bayssade-Dufour (1979). Chez *Notocotylus* et *Catatropis*, le grand nombre de sensilles, à ces niveaux, semble manifester, tout au contraire, un haut degré d' évolution.

La distinction entre les genres de Notocotylidae, établie par Odhner (1905) se fonde sur le nombre de crêtes et de papilles ventrales des vers adultes, considéré comme stable par Lal (1935), Gorchilova et Kanev (1988), Gorchilova et al. (1992), cependant, elles sont difficiles à observer en microscopie photonique, selon Noble (1933), Harwood (1939) et Bullock (1952) car ces structures peuvent être, ou non, protubérantes. *Notocotylus* possède trois rangées de papilles, *Catatropis*, une crête et deux rangées de papilles.

La chétotaxie cercarienne de *Notocotylus attenuatus*, *N. ephemera* et *N. zduni*, décrite par Kanev et al. (1985) révèle que le genre n'est pas homogène: *N. attenuatus* et *N. ephemera* ont plus de sensilles céphaliques que *N. zduni*; par ailleurs, les trois *Notocotylus* ont une chétotaxie caudale variant avec l'espèce. D'ordinaire, les espèces du même genre et de genres proches, ont une chétotaxie caudale identique, les espèces de même genre ayant une chétotaxie céphalique très proche. *Catatropis lagunae* a une chétotaxie céphalique proche de celles de *N. attenuatus* et *N. ephemera* et une chétotaxie caudale semblable à celle de *N. zduni*. Par ailleurs, le microscope électronique à balayage montre que la structure d'une crête est totalement identique à celle d'une papille ventrale (figure 3K, M). Le concept d'Odhner devrait être complété.

**La pathogénicité des Notocotyles.** Ces vers provoquent une anémie mortelle chez leurs hôtes lorsqu'ils s' y trouvent en très grand nombre; ce sont les crêtes et papilles ventrales qui ont des fonctions liées au pouvoir pathogène, selon Dike (1969) et Radlett (1980). Mac Kinnon (1981, 1982a, b) montre que ces structures ont une activité permettant l'oogenèse des vers adultes. *Anser*, *Anas* et *Cairina* s'avèrent être de bons modèles expérimentaux pour l'étude des Helminthiases à Notocotylidae.

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# Road Mortality of Amphibians, Reptiles and Other Wildlife on the Long Point Causeway, Lake Erie, Ontario

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Ashley, E. Paul, and Jeffrey T. Robinson. 1996. Road mortality of amphibians, reptiles and other wildlife on the Long Point causeway, Lake Erie, Ontario. Canadian Field-Naturalist 110(3): 403–412.

Wildlife road mortality on a 3.6 km section of a two-lane paved causeway adjacent to Big Creek National Wildlife Area on Lake Erie was censused from spring to autumn for two 2-year periods, 1979-1980 and 1992-1993. Total recorded mortality exceeded 32 000 individuals, the majority being young of the year Leopard Frogs. One hundred vertebrate species were recorded, 7 amphibians (n = 30 034), 10 reptiles (n = 864), 21 mammals (n = 282) and 62 birds (n = 1302). Amphibian (Leopard Frog, Bullfrog, Green Frog, American Toad) and reptile (Painted Turtle, Snapping Turtle, Blanding's Turtle and Garter Snake) mortality showed seasonal patterns consistent with life history phenology. Amphibian mortality was significantly associated with adjacent roadside vegetation and turtle road mortality with adjacent open water areas ($P \leq 0.05$). Factors that influence herpetofaunal road mortality and management options for reducing mortality on the causeway are discussed.

Key Words: amphibians, reptiles, mammals, birds, mortality, road, causeway, vehicle, wetland.

Roads, once restricted by topography, now traverse almost any terrain. Far from being innocuous features of the landscape, roads affect wildlife by altering and isolating habitat (Mader 1984; Foster 1992) and populations (Reh 1989), deterring the movement of wildlife (Garland and Bradley 1984; Mader 1984; Dalrymple and Reichenbach 1984) and promoting extensive wildlife mortality (Oxley et al. 1974; Gelder 1973; Case 1978; Rosen and Lowe 1994). This is perhaps most evident when roads are constructed through wetlands.

In Ontario, highway 59 crosses the eastern edge of the Big Creek National Wildlife Area (BCNWA) on the north shore of Lake Erie along a 3.6 kilometre raised earth asphalt causeway, joining the mainland to the Long Point peninsula (Figure 1). The causeway cuts across the wetland-bay continuum and divides the habitat of many wetland species. Many amphibians, reptiles, birds and mammals of the adjacent Big Creek wetland are killed on the road. Some animals are simply trying to cross to habitat on the other side whereas others make use of the habitat and conditions created by the road and roadbed. The vast majority of the annual road mortality on the causeway are amphibians and reptiles. These species migrate along and across the highway seasonally to find suitable foraging, breeding, nesting and overwintering sites, while at other times they use roadside habitat itself. Some species also use the highway for thermoregulation. Roadways also attract birds and mammals where they find digestive grit, water puddles, food, nesting sites (Dhindsa et al. 1988) and dispersal corridors (Getz et al. 1978; Huey 1941).

To investigate the extent of this mortality, censuses were performed by the Canadian Wildlife Service (CWS) in 1979 and 1980 and again in 1992 and 1993. In this paper we report the vehicular induced road mortality, and for amphibians and reptiles identify habitats associated with significant crossing areas and discuss seasonal patterns of road mortality.

## Study Area

The Big Creek wetland is part of a 1200 ha wetland west of highway 59 at the head of Long Point Bay on Lake Erie, Regional Municipality of Haldimand-Norfolk, centred at 42°35′15″ N, 80°27′30″ W. The wetland is shallow and dominated by Bluejoint Grass (*Calamagrostis canadensis*) and Sedges (*Carex* spp.). Deeper water emergents are found around large ponds within the wetland.

Since 1973 the eastern 600 ha of the wetland has been managed by the Canadian Wildlife Service of Environment Canada as the Big Creek National Wildlife Area (BCNWA). In 1982 the Long Point wetlands were designated as a Ramsar site identifying them as "Wetlands of International Importance". The Long Point ecosystem was designated as a World Biosphere Reserve by the Man and the Biosphere Program of UNESCO in 1986.

This ecosystem provides habitat for 34 species of amphibians and reptiles (Gartshore 1987). Two herptiles found at BCNWA, the Spotted Turtle (*Clemmys guttata*) and the Fowler's Toad (*Bufo woodhousii fowleri*) are listed as "vulnerable" by the Committee on the Status of Endangered Wildlife in Canada. (COSEWIC 1986). Provincially significant populations of Blanding's Turtles (*Emydoidea blandingi*) and Fox Snake (*Elphae vulpina gloydi*) are also found in the wetland.

In 1926 a two-lane causeway was constructed on earth fill, providing road access to the Long Point peninsula. Since then, the highway has been raised to 1.5 metres above mean summer lake level. Two of three original bridges have been eliminated by fill. The remaining bridge spans Big Creek near its mouth. The causeway is paved, 7 m wide with 1 m gravel shoulders. Undeveloped sections of the causeway are protected by concrete rubble and rock. The posted speed limit is 70 km/hr.

Since the early study (1979-1980) there has been increased development along sections of the causeway and the Big Creek wetland has undergone major structural changes (Table 1). To create a more diverse wetland, 89 ha of the wetland were impounded by a dyke system in 1985. Approximately 1400 metres of the dyke and borrow ditch parallels the causeway, fifty metres west of the highway.

To document the influence of localized roadside habitat on road mortality, the causeway was subdivided into five sampling sections, labelled A - E (Figure 1). These sections correspond to zones of development and habitat along the causeway. The roadside habitat was mapped in 1979 and again in 1992 to document changes in vegetation and development. The total length of the sampled section of the causeway is 3.56 km.

## Methods

*Road-Kill Count*

The causeway was surveyed by walking or bicycling along the shoulder every Monday, Wednesday and Friday beginning in April (except 1979 when sampling began in June) and concluding at the end of October. All carcasses found between the outer shoulders of the road were recorded. The species, location along the causeway, and age (adult or after hatching year, immature or hatch year) were recorded if possible. If identification was not possible, then the lowest taxonomic group was recorded. Specimens were removed to avoid later duplication.

Identification of road-kills can be difficult due to deterioration of carcasses by traffic and weather. The category of "unidentified anurans" is comprised largely of specimens that were either small Bullfrogs (*Rana catesbeiana*) or Green Frogs (*Rana clamitans*) and toads that were either Common (*Bufo americanus americanus*) or Fowler's as well as Chorus Frogs (*Pseudacris triseriata triseriata*), Gray Treefrogs (*Hyla versicolor*) and possibly Spring Peepers (*Pseudacris crucifer*). This data does not fully represent the total road mortality during the period studied as road-killed furbearers Mink (*Mustela vison*), Raccoon (*Procyon lotor*) and Muskrat (*Ondatra zibethica*) are occasionally removed for their pelts, birds for study skins and Bullfrogs for their legs. Scavengers also feed on carcasses along the causeway.

Traffic volume information, expressed as average summer daily (24 hour) two-way traffic was obtained from Ontario Ministry of Transportation. Associations of road mortality between road segments were tested using Chi square tests with expected frequencies adjusted to compensate for the differing lengths of road.

## Results and Discussion

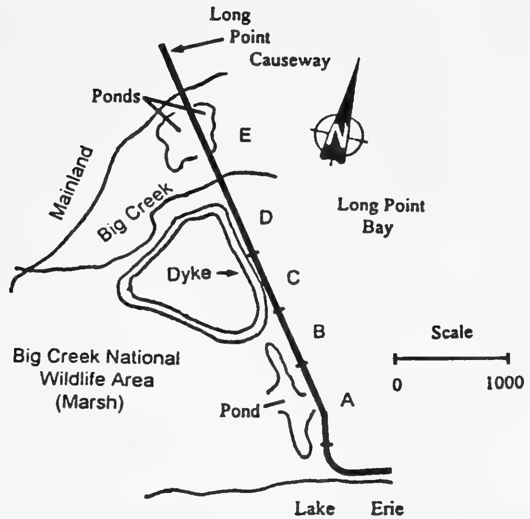
*Species Composition of Road Mortality*

One-hundred vertebrate species were identified: 7 amphibian, 10 reptiles, 21 mammals and 62 birds. All known species of amphibian and reptiles endemic to the Big Creek Wetland except Spring Peeper, Wood Frog (*Rana sylvatica*) and the aquatic Mudpuppy (*Necturus maculosus*) were recorded during the study. Of the 25 species of mammals known to inhabit BCNWA (McKeating and Dewey 1984), 20 were encountered as road mortalities. One feral cat (*Felis domesticus*) was also found. Those species not recorded as road mortalities are the Norway Rat (*Rattus norvegicus*), Red Fox (*Vulpes vulpes*), Coyote (*Canis latrans*), Striped Skunk (*Mephitis mephitis*) and White-tailed Deer (*Odocoileus virginianus*). More than 300 species of birds seasonally migrate through the area and 80 seasonally nest in BCNWA (McCracken 1979) .

Total observed road mortality over the four years exceeded 32 000 individuals, 27 846 (85.4%) being Leopard Frogs. Amphibians accounted for 92.1% of the total road mortality, reptiles 2.7%, birds 4.3%, and mammals 0.9%. (Table 1)

Road mortality of birds was much higher in 1979 than the other three years. Of note is the decline in Red-winged Blackbirds (*Agelaius phoeniceus*) and Long-billed Marsh Wrens (*Cistothorus palustris*). Some of this apparent decline may be explained by the higher percentage of unidentified birds in the latter studies. Trends for the other species groups were not as evident. One species, the Opossum (*Didelphis marsupialis*) appears to have expanded its range into the Long Point area in the interval between the studies. None were recorded during the early study, but 19 were recorded during 1992 and 1993.

Wetlands are one of the most dynamic, productive and diverse of all natural systems, consequently roads through them can be particularly detrimental to habitat and wildlife. A comparison between this study and one performed by Oxley et al. (1974) shows much lower road mortality/km/sampling day for all groups along sections of highways 7A and 7B in the counties of Frontenac, Lanark, Leeds and Russell that border mixed hardwood forest in southeastern Ontario. Over the four-year (716 day) study period between the months of April and October road mortality on the causeway averaged the following: 11.65 amphibians/km/day, 0.34 reptiles/km/day, 0.51 birds/km/day and 0.11 mammals/km/day. In




**Legend:**

| Section | Length (m) | Current habitat west side | Current habitat east side | Change since initial survey |
|---|---|---|---|---|
| A | 816 | dominated by bluejoint grass, sedges, bulrush and cattails; 250 m is an open pond adjacent to the road | three marinas occur along this segment with no natural habitat remaining. | yes, east side has had development of a trailer park on former wetlands |
| B | 627 | dominated by cattail and bluejoint grass | open water with scattered cattail and bulrush along the shoreline | no |
| C | 662 | cattail dominated wetland community with deep borrow ditch 50-70 m from the roadway which parallels a dike | cattail and bulrush community extending 30 m into the water | yes, west side has had diking for marsh management activity |
| D | 1453 | similar to C above | half of this segment has cottage development. Remaining areas are cattail dominated | yes, west as above and east side has seen some new cottage construction and installation of vertical steel breakwalls |
| E | 728 | 10 m of cattails extends into shallow pond along the entire segment | bordered by a diked cattail marsh with a channel running parallel with the road 30 m into the marsh. A small open pond is adjacent to the road at the north end of this segment | no |

FIGURE 1. Map of Point causeway sampling sections.

TABLE 1. Road mortality on the Long Point causeway over a four year period.

| **Amphibians** | | 1979 | 1980 | 1992 | 1993 |
|---|---|---|---|---|---|
| Northern Leopard Frog | *Rana pipiens* | 9172 | 10753 | 445 | 7476 |
| Bullfrog | *Rana catesbeiana* | 576 | 514 | 101 | 154 |
| Green Frog | *Rana clamitans* | 12 | 19 | 26 | 10 |
| Western Chorus Frog | *Pseudacris triseriata triseriata* | 0 | 0 | 12 | 0 |
| Gray Treefrog | *Hyla versicolor* | 0 | 0 | 4 | 11 |
| American Toad | *Bufo americanus americanus* | 164 | 55 | 83 | 131 |
| Fowler's Toad | *Bufo woodhousii fowleri* | 12 | 16 | 0 | 1 |
| Unidentified Anurans | | 104 | 109 | 40 | 34 |
| Total Amphibians | | 10040 | 11466 | 711 | 7817 |
| **Reptiles** | | | | | |
| Painted Turtle | *Chrysemys picta marginata* | 95 | 74 | 93 | 79 |
| Spotted Turtle | *Clemmys guttata* | 1 | 0 | 7 | 9 |
| Snapping Turtle | *Chelydra serpentina* | 75 | 74 | 45 | 78 |
| Blanding's Turtle | *Emydoidea blandingii* | 19 | 7 | 17 | 18 |
| Map Turtle | *Graptemys geographica* | 12 | 5 | 2 | 6 |
| Eastern Garter Snake | *Thamnophis sirtalis sirtalis* | 26 | 43 | 13 | 32 |
| Northern Water Snake | *Nerodia sipedon* | 4 | 2 | 0 | 2 |
| Fox Snake | *Elaphe vulpina gloydi* | 5 | 13 | 3 | 3 |
| Eastern Milk Snake | *Lampropeltis triangulum triangulum* | 0 | 1 | 0 | 0 |
| Northern Ribbon Snake | *Thamnophis sauritus septentrionalis* | 0 | 0 | 0 | 1 |
| Total Reptiles | | 237 | 219 | 180 | 228 |
| **Birds** | | | | | |
| Tree Swallow | *Iridoprocene bicolor* | 19 | 11 | 12 | 18 |
| Barn Swallow | *Hirundo rustica* | 40 | 20 | 2 | 3 |
| Rough-winged Swallow | *Stelgidopteryx ruficollis* | 0 | 0 | 2 | 0 |
| Cliff Swallow | *Petrochelidon pyrrhonota* | 0 | 0 | 12 | 1 |
| Bank Swallow | *Riparia riparia* | 13 | 6 | 75 | 18 |
| Purple Martin | *Progne subis* | 11 | 10 | 13 | 2 |
| House Sparrow | *Passer domesticus* | 13 | 19 | 1 | 1 |
| White-throated Sparrow | *Zonotrichia albicollis* | 2 | 5 | 2 | 0 |
| Song Sparrow | *Melospiza melodia* | 2 | 0 | 2 | 3 |
| Swamp Sparow | *Melospiza georgiana* | 53 | 8 | 10 | 1 |
| Savanah Sparrow | *Passerculus sandwichensis* | 0 | 1 | 1 | 0 |
| Chipping Sparrow | *Spizella passerina* | 0 | 0 | 0 | 1 |
| House Finch | *Carpodacus mexicanus* | 0 | 0 | 0 | 2 |
| Long-billed Marsh Wren | *Cistothorus palustris* | 35 | 14 | 3 | 6 |
| Cedar Waxwing | *Bombycilla cedrorum* | 3 | 1 | 0 | 0 |
| Hermit Thrush | *Catharus guttatus* | 0 | 1 | 0 | 0 |
| Swainson's Thrush | *Catharus ustulatus* | 1 | 0 | 0 | 0 |
| American Robin | *Turdus migratorius* | 4 | 8 | 10 | 3 |
| Brown Thrasher | *Toxostoma rufum* | 4 | 1 | 1 | 0 |
| Gray Catbird | *Dumetalla carolinensis* | 0 | 2 | 1 | 0 |
| European Starling | *Stumus vulgaris* | 51 | 26 | 39 | 16 |
| Common Grackle | *Quiscalus quiscula* | 25 | 11 | 0 | 0 |
| Brewer's Blackbird | *Euphagus cyanocephalus* | 0 | 0 | 0 | 1 |
| Red-winged Blackbird | *Agelaius phoeniceus* | 142 | 67 | 8 | 11 |
| Common Yellowthroat | *Geothlypis trichas* | 9 | 4 | 0 | 0 |
| Northern Oriole | *Icterus galbula* | 1 | 0 | 0 | 0 |
| Brown-headed Cowbird | *Molothrus ater* | 1 | 0 | 0 | 0 |
| Yellow-shafted Flicker | *Colaptes auratus* | 1 | 1 | 0 | 1 |
| Mourning Dove | *Zanaida macroura* | 0 | 1 | 0 | 0 |
| Rock Dove | *Columba livia* | 0 | 1 | 0 | 0 |
| Yellow-billed Cuckoo | *Coccyzuz americanus* | 0 | 1 | 0 | 0 |
| Black-billed Cuckoo | *Coccyzus erythropthalmus* | 2 | 1 | 0 | 0 |
| Eastern Kingbird | *Tyrannus tyrannus* | 5 | 4 | 1 | 0 |
| Willow Flycatcher | *Empidonax traillii* | 0 | 0 | 1 | 0 |
| Siate-colored Junco | *Junco hyemalis* | 0 | 0 | 0 | 1 |
| Eastern Wood Pewee | *Contopus virens* | 0 | 2 | 0 | 0 |
| Common Nighthawk | *Chordeiles minor* | 1 | 0 | 0 | 0 |

*Continued*

TABLE 1. *Concluded*

| **Birds** | | 1979 | 1980 | 1992 | 1993 |
|---|---|---|---|---|---|
| Common Gallinule | *Gallinula chloropus* | 3 | 0 | 0 | 0 |
| American Coot | *Fulica americana* | 0 | 1 | 0 | 0 |
| Killdeer | *Charadrius vociferus* | 5 | 5 | 0 | 0 |
| Semi-palmated Sandpiper | *Calidris pusilla* | 2 | 0 | 0 | 0 |
| Mallard | *Anas platyrhynchos* | 9 | 0 | 0 | 0 |
| Wood Duck | *Aix sponsa* | 0 | 1 | 0 | 0 |
| Canada Goose | *Branta canadensis* | 0 | 0 | 7 | 0 |
| Common Merganser | *Mergus merganser* | 0 | 0 | 0 | 0 |
| Common Snipe | *Capella gallinago* | 1 | 1 | 0 | 0 |
| Sora | *Porzana carolina* | 1 | 2 | 2 | 0 |
| Clapper Rail | *Rallus longirostris* | 0 | 0 | 0 | 1 |
| Virginia Rail | *Rallus limicola* | 2 | 2 | 0 | 0 |
| Short-billed Dowitcher | *Limnodromus griseus* | 1 | 0 | 0 | 0 |
| Ring-billed Gull | *Larus delawarensis* | 0 | 0 | 0 | 2 |
| Belted Kingfisher | *Megaceryle alcyon* | 1 | 0 | 0 | 0 |
| Palm Warbler | *Dendrocia palmarum* | 0 | 1 | 0 | 0 |
| Myrtle Warbler | *Dendrocia coronata* | 0 | 1 | 0 | 0 |
| Yellow Warbler | *Dendrocia petechia* | 2 | 3 | 8 | 6 |
| Northern Waterthrush | *Seiurus noveboracensis* | 0 | 0 | 0 | 1 |
| American Goldfinch | *Carduelis tristis* | 0 | 1 | 2 | 2 |
| Golden-crowned Kinglet | *Regulus satrapa* | 4 | 0 | 0 | 0 |
| Least Bittern | *Ixobrychus exilis* | 1 | 1 | 2 | 1 |
| American Bittern | *Botaurus lentiginosus* | 0 | 1 | 0 | 0 |
| Saw-whet Owl | *Aegolius acadicus* | 0 | 0 | 2 | 0 |
| Domestic Chicken | *Gallus gallus* | 0 | 1 | 0 | 0 |
| Unidentified Birds | | 32 | 40 | 70 | 106 |
| Total Birds | | 502 | 287 | 289 | 224 |
| **Mammals** | | | | | |
| Opossum | *Didelphis marsupialis* | 0 | 0 | 12 | 7 |
| Short-tailed Shrew | *Blarina brevicauda* | 5 | 7 | 0 | 2 |
| Star-nosed Mole | *Condylura cristata* | 0 | 1 | 0 | 0 |
| Little Brown Bat | *Myotis lucifugus* | 1 | 0 | 1 | 0 |
| Red Bat | *Lasiurus borealis* | 4 | 0 | 0 | 0 |
| Long-tailed Weasel | *Mustela frenata* | 9 | 1 | 0 | 1 |
| Short-tailed Weasel | *Mustela erminea* | 11 | 1 | 1 | 0 |
| Mink | *Mustela vison* | 6 | 10 | 14 | 11 |
| Woodchuck | *Marmota monax* | 0 | 0 | 3 | 2 |
| Raccoon | *Procyon lotor* | 0 | 2 | 13 | 3 |
| American Red Squirrel | *Tamiasciurus hudsonicus* | 0 | 0 | 1 | 0 |
| Eastern Chipmunk | *Tamias striatus* | 0 | 0 | 0 | 1 |
| Eastern Gray Squirrel | *Sciurus carolinensis* | 0 | 0 | 1 | 0 |
| Meadow Jumping Mouse | *Zapus hudsonius* | 26 | 7 | 10 | 0 |
| Deer Mouse | *Peromyscus maniculatus* | 0 | 7 | 9 | 1 |
| House Mouse | *Mus musculus* | 0 | 0 | 0 | 1 |
| White-footed Mouse | *Peromyscus leucopus* | 3 | 0 | 0 | 0 |
| Meadow Vole | *Microtus pennsylvanicus* | 23 | 13 | 12 | 9 |
| Muskrat | *Ondatra zibethica* | 2 | 1 | 1 | 2 |
| Eastern Cottontail | *Sylvilagus floridanus* | 2 | 2 | 2 | 1 |
| Domestic Cat | *Felis domesticus* | 1 | 0 | 0 | 1 |
| Mouse spp. | | 0 | 5 | 9 | 11 |
| Unidentified Mammals | | 0 | 9 | 0 | 1 |
| Total Mammals | | 93 | 66 | 89 | 54 |
| Total Road Mortality | | 10872 | 12038 | 1269 | 8323 |

Census Dates:
1979: 8 June - 26 October; 1980: 18 April - 31 October; 1992: 27 April - 30 October; 1993: 16 April - 28 October.

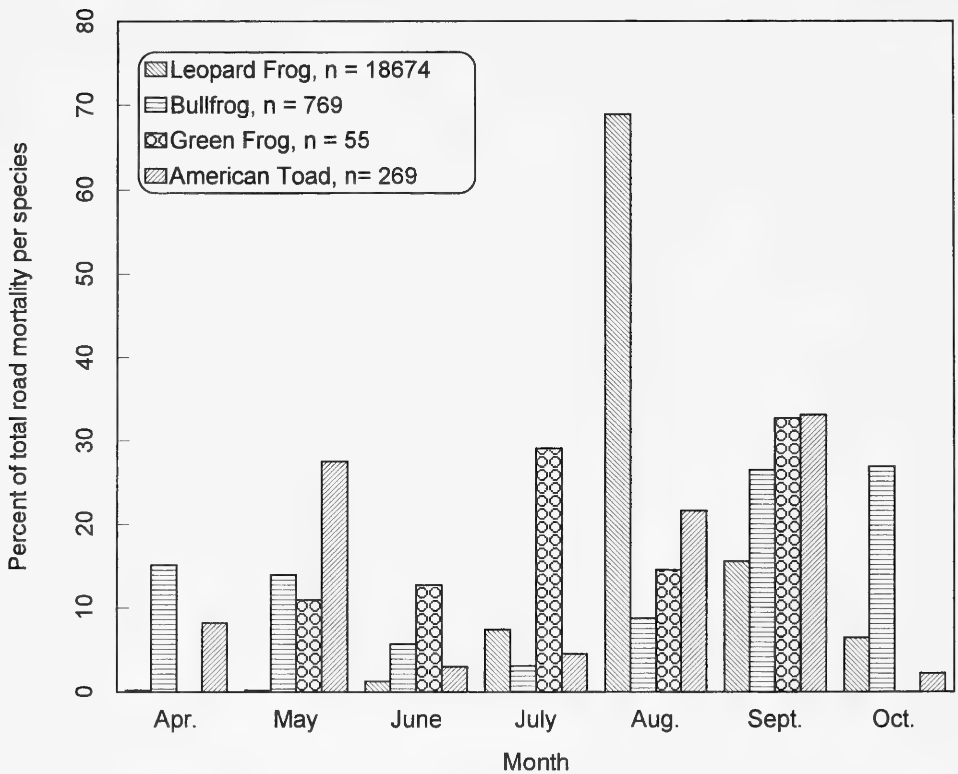



FIGURE 2. Monthly road mortality of selected amphibians on the Long Point causeway as a percent of total road mortality per species, 1980, 1992, 1993 (1979 data excluded).

comparison, over a 116 day period between 1 June and 18 September 1972 Oxley et al. (1974) observed road mortality at the following rates: 0.02 amphibians/km/day (< 1% of our average), 0.03 reptiles/km/day (9%), 0.03 birds/km/day (5%) and 0.04 mammals/km/day (36%).

Of wildlife groups most associated with wetlands, amphibians and reptiles are especially vulnerable to road mortality. Compared to homeothermic animals they are characteristically slow and not cognizant of the danger presented by passing vehicles. Certain species are more vulnerable to road mortality along the causeway than others. Short-lived species producing many young have by far the greatest number of annual road mortality. Within this group, some species are more likely victims of road mortality than others. Critical factors include use of roadside habitat found along and adjacent to the causeway and life histories. For example, Chorus Frogs and Spring Peepers are heard in high numbers along sections A and B in the spring but comprise a relatively small proportion of the overall amphibian road mortality.

The only amphibian species encountered regularly were the Leopard Frog, Bullfrog, Green Frog and American Toad. Very high counts of Leopard Frog road mortality were recorded in 1979, 1980 and 1993. Road mortality for 1992 Leopard Frogs and Bullfrogs was comparatively very low but Leopard Frog numbers in 1993 increased to counts comparable to earlier surveys. Bullfrogs showed a slight increase in 1993 but were still less than 30% of the counts recorded during the 1979 - 1980 study. Counts of American Toads followed a similar trend to that of Leopard Frogs. The observed low counts of Leopard Frog road mortality and many other amphibians and reptiles in 1992 are indicative of poor spawning or recruitment success in a previous year. Alternatively, a shortened dispersal period occurring during periods of lesser traffic volume may also be responsible for the low numbers.

Road mortality of reptiles remained relatively constant over the four-year study period with the exception of the Spotted Turtle (n = 17) which increased from 1 in 1979 to 9 in 1993. This pattern coincides with observations that indicate that the local population is increasing. The most common reptile road mortality was the Painted Turtle (*Chrysemys picta marginata*) (n = 341), followed by the Snapping Turtle (*Chelydra serpentina*) (n = 272). The Spotted,

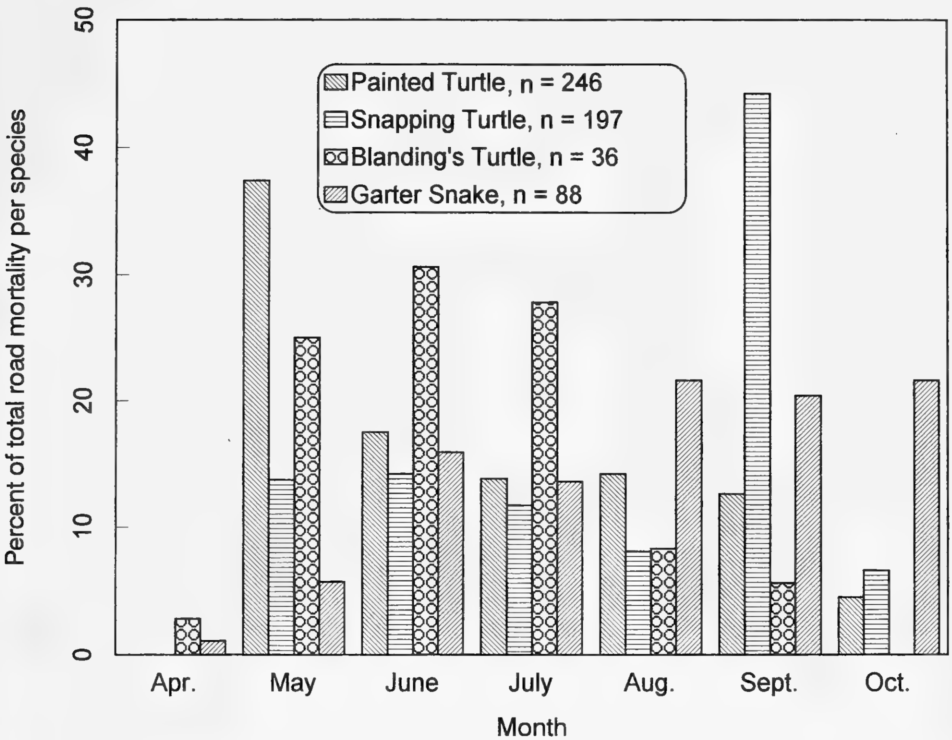



FIGURE 3. Monthly road mortality of selected reptiles on the Long Point causeway as a percent of total road mortality per species 1980, 1992, 1993 (1979 data excluded).

Blanding's and more aquatic Map Turtle (*Graptemys geographica*) had lower road mortality although the populations of these latter species do not appear as high as the Painted and Snapping Turtles. The most common snake road mortality was the Eastern Garter Snake (*Thamnophis sirtalis sirtalis*) (n = 114). Annual road mortality of both Garter Snake and Fox Snake were the greatest in 1980.

An important factor in the composition of road mortality is the time of day the causeway is occupied by wildlife. Mature reptiles tend to occupy the causeway during the afternoon, which increases the likelihood of collisions, especially species that bask on the highway and use it as a thermoregulatory source. Conversely most amphibian migration across the causeway occurs at night when use by motorists is at a daily minimum.

Several studies have addressed the issue of traffic volume on anuran population densities. A study of the breeding migration of the Common Toad (*Bufo bufo*) by van Gelder (1973) estimated that 60 cars/hour passing by his site would kill ninety percent of the adult toads during breeding migration. Reh and Seitz (1990) report two other studies on the impact of road mortality on the Common Toad. In the first, Kuhn (1987) found that 50% of the migrating toads at his site were killed at a traffic volume of 24 - 40 cars per hour, and Heine (1987) concluded that a rate of 26 cars per hour passing by his site would kill all migrating toads. Even along lightly travelled roadways adjacent to wetlands Palis (1994) found road mortality of amphibians to be high. Average daily two-way traffic volume on the causeway during the summer months increased 9% from 2800 in 1978 to 3050 in 1992. With a summer daily traffic volume on the causeway in 1992 of 127 cars per hour it is most probable that some anuran populations are experiencing a significant negative effect.

*Seasonal Patterns of Mortality*

In general, wildlife road mortality on the causeway follows the observed trend of seasonal highs in the spring and autumn (Case 1978). Mortality patterns of amphibians are readily explained by the life history pattern of each species; particularly reproduction and dispersal. Total road mortality of the four dominant amphibian and reptile species compiled monthly for the years 1980, 1992, 1993 show unimodal and bimodal patterns (Figure 2). Because sampling began in June of 1979, that year's data were excluded. Leopard Frog road mortality is unimodal. The first road mortality appeared in April,

TABLE 2. Amphibian and reptile road mortality per kilometre and per cent of annual mortality by section of causeway.

| | Section | 1979 | | 1980 | | 1992 | | 1993 | |
|---|---|---|---|---|---|---|---|---|---|
| | | kill/km | % | kill/km | % | kill/km | % | kill/km | % |
| Amphibian | A | 2430 | 20 | 1629 | 12 | 192 | 23 | 3826 | 40 |
| | B | 3720 | 23 | 4758 | 26 | 187 | 17 | 6059 | 49 |
| | C | 3894 | 26 | 6506 | 38 | 166 | 16 | 600 | 5 |
| | D | 3901 | 28 | 3674 | 23 | 88 | 18 | 404 | 4 |
| | E | 438 | 3 | 251 | 2 | 258 | 27 | 268 | 2 |
| Mean | | 2821 | | 3223 | | 195 | | 2194 | |
| Reptile | A | 110 | 38 | 98 | 37 | 62 | 28 | 77 | 28 |
| | B | 30 | 8 | 35 | 10 | 35 | 12 | 46 | 13 |
| | C | 38 | 10 | 42 | 13 | 50 | 18 | 50 | 14 |
| | D | 48 | 15 | 61 | 20 | 47 | 21 | 54 | 17 |
| | E | 93 | 29 | 60 | 20 | 50 | 20 | 87 | 28 |
| Mean | | 66 | | 61 | | 50 | | 64 | |

but only 0.2% of the species' cumulative total. Mortalities increased by month until a maximum of 68.9% of the annual total was reached in August. Ninety-nine per cent of Leopard Frog road mortality in August were juveniles. Road mortality then decreased steadily through to October.

Bullfrog road mortality is bimodal. Bullfrogs were encountered in April and May in proportionally high numbers as they leave overwintering sites in the Bay and cross the causeway to spawning sites in the wetland. Road mortality then decreased throughout the late spring and early summer. Road mortality increased in August and reached a maximum of 26.5 and 26.9% of the annual Bullfrog road mortality in September and October respectively.

The pattern of Green Frog road mortality is similar but occurred over the fewest months (May - September) of the four amphibian species. Green Frog road mortality first occurred in May and increased in June and July with a slight decrease in August. Maximum road mortality of 32.7% of the annual total occurred in September. No Green Frog road mortality was observed in October. American Toad road mortality was also bimodal, increasing from April to May, then decreasing throughout the summer and occurring in high numbers in August and September.

Seasonal patterns of road mortality of all observed reptiles were unimodal (Figure 3) and is largely dependent upon breeding and nesting behaviour and thermoregulation. Road mortality of most species of reptiles did not occur until May. The most commonly observed reptile road mortality, Painted Turtle reached its highest monthly percentage (37.4%) in May with 75% of the road mortality being overwintering hatchlings dispersing from roadside nests.

Snapping Turtle road mortality also did not occur until May and remained at a constant rate until September when 44.2% of annual road mortality was recorded. The monthly per cent composition of Snapping Turtle hatch year individuals from May to September is 89, 69, 67, 90 and 100% respectively.

Blanding's Turtle road mortality occurred earlier than other turtles, beginning in April. Road mortality increased steadily to a maximum in June and then decreased through to September. No Blanding's Turtle road mortality was recorded in October.

Road mortality of the Garter Snake was observed during every month of the study. The pattern is of increasing mortality throughout the spring and early summer, then levelling off at approximately 20% per cent for the months of August through to October. Thermoregulation appears to be the dominant factor in Garter Snake road mortality as they were frequently observed basking on the causeway. Dalrymple and Reichenbach (1984) noted road mortality of snakes using Ohio roadways in the fall for thermoregulation, and over a two year period Bernardino and Dalrymple (1992) found that 73% of 155 snakes observed on the roads in the Everglades National Park were either injured or dead.

*Association of Mortality and Roadside Habitat*

Although the entire causeway traverses wetland, meso-habitat conditions (i.e., vegetation communities and roadside development) influenced road mortality and species composition within sections. For the most common amphibians (Leopard Frog, Bullfrog) and reptiles (Painted Turtle and Snapping Turtle), chi-square tests indicate that within each study period road mortality was significantly ($p \leq 0.05$) associated with the section of road. Since the sections are of differing lengths road mortality for each section is expressed as road mortality/km. Sections A to D had high proportions of the amphibian road mortality in the early study (Table 2). In 1993, 89% of amphibian road mortality was concentrated in sections A and B. Amphibian road mortality occurred more evenly across the causeway in 1992,

possibly a consequence of the low annual count. Annual road mortality/km of amphibians occurred comparatively less often in section E of the causeway over the four-year period (Table 2). The ends of the causeway, (A and E) with adjacent shallow ponds produced the majority of turtle road mortality. Section B characterized by shallow water emergents (Bluejoint, Sedge) consistently produced the lowest turtle road mortality on the adjacent causeway.

A chi-square comparison of the spatial distribution of road mortality along the causeway of the most frequently occurring amphibian and reptilian species showed significant ($p \leq 0.05$) differences between the 1979-1980 study and the 1992-1993 study except Snapping Turtles in section E. When the impoundment and dyke were constructed along sections C and D in 1985, the borrow ditch along the dyke improved water circulation and increased water depth between the dyke and the causeway. The vegetation community responded by shifting from a shallow wetland community dominated by Bluejoint and *Carex* to a deeper water community dominated by Cattail. This change in community structure altered the species composition of amphibians and reptiles along these sections of the causeway.

Use of this area (C and D) by the semi-terrestrial Leopard Frog appears to have decreased as indicated in the reduction of road mortality. With less Leopard Frog habitat adjacent to the causeway those sections possessing drier wetland adjacent to the causeway (A and B) produced the majority of road mortality in the latter study. The change in habitat created more favourable conditions for the more aquatic Bullfrog and corresponding road mortality increased. Both the Painted Turtle and the Snapping Turtle showed significant ($P \leq 0.05$) increases in road mortality in section C and decreases in section D in the latter study period. The borrow ditch and dyke in this section created overwintering and nesting sites for turtles in this area of the wetland.

*Management Considerations*

The most important aspect of this study is the clear demonstration that, compared to other habitats, road mortality along the causeway (and presumably along all wetlands) is very high. Assessing the impact of road mortality on fluctuating wildlife populations is often difficult (van Gelder 1973; Langston 1989). Recently, Fahrig et al. (1995) studied several disparate populations of anurans under different intensities of traffic volume and concluded that road mortality has a significant negative effect on the density of local anuran populations. Some wildlife populations along the causeway are probably being depressed through the added mortality presented by the road, while road mortality in other populations may have little effect. Such uncertainty underscores the need for continued long term monitoring and the cautious interpretation of short-term data, but should not curtail current conservation efforts. Reducing amphibian and reptile road mortality has focused on identifying why and where certain species are crossing the causeway. In response, several experimental initiatives have been implemented, including drift fencing leading to a culvert, alternative nesting sites for turtles, and erection of wildlife crossing signs.

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# The Meningeal Worm, *Parelaphostrongylus tenuis*, a Marginal Limiting Factor for Moose, *Alces alces*, in Southern Québec

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Dumont, André, and Michel Crête. 1996. The meningeal worm, *Parelaphostrongylus tenuis*, a marginal limiting factor for Moose, *Alces alces*, in southern Québec. Canadian Field-Naturalist 110(3): 413–418.

We estimated the relative importance of the meningeal worm (*Parelaphostrongylus tenuis*) as a limiting factor of Moose (*Alces alces*) populations living in sympatry with White-tailed Deer (*Odocoileus virginianus*) in southern Québec, using a questionnaire. We recorded 84 cases of moose showing typical signs of infection by the meningeal worm, 61 during the 1983-1992 period. There was close agreement between deer distribution and the location of symptomatic Moose. Signs of infection with the meningeal worm appeared equally between sexes in animals older than 1 year of age, but symptomatic calves were observed less often than expected. We found a significant linear relationship ($r^2 = 0.80$; d.f. = 8) between apparent infection rate (observed cases•10 000 moose$^{-1}$•yr$^{-1}$) and estimated deer density. At the scale of hunting zones, we found no evidence of refugia in which moose would be protected from the parasite. Reported cases of symptomatic moose always represented less than 1% of total moose populations; monitoring of 149 radio-collared moose in two areas of southern Québec for other purposes also suggested an apparent annual mortality rate from parelaphostrongylosis of <1%. White-tailed Deer densities are probably not high enough to prevent the establishment of Moose populations anywhere in Québec. This limiting factor, however, diminishes the demographic vigour of infected populations, and the potential hunting harvest.

Nous avons estimé, à l'aide d'un questionnaire, l'importance relative du ver des méninges (*Parelaphostrongylus tenuis*) comme facteur limitatif des populations d'orignaux (*Alces alces*) du sud du Québec cohabitant avec le cerf de Virginie (*Odocoileus virginianus*). Nous avons enregistré 84 cas d'orignaux montrant des signes typiques d'une infection par le ver des méninges. Il y avait concordance étroite entre la distribution du cerf et la localisation des orignaux affectés. Les signes d'infection apparurent également chez les mâles et les femelles de plus d'un an, mais l'incidence chez les faons fut moindre que leur abondance dans la population d'orignaux. Nous avons trouvé une relation linéaire significative ($r^2 = 0.80$; d.l. = 8) entre le taux apparent d'infection (cas observés•10 000 orignaux$^{-1}$•an$^{-1}$) et la densité estimée de cerfs. A l'échelle des zones de chasse, nous n'avons pas trouvé d'évidences de présence de refuges où les orignaux seraient protégés du parasite. Les cas rapportés ont toujours représenté moins de 1% des effectifs; le suivi, à d'autres fins, de 149 orignaux munis de colliers émetteurs dans 2 endroits du sud du Québec a aussi suggéré un taux annuel de mortalité attribuable au ver des méninges de moins de 1%. Les densités de cerf de Virginie ne sont probablement pas suffisamment élevées au Québec pour empêcher l'établissement de l'orignal à quelque endroit que ce soit. Cependant, le ver des méninges diminue la vigueur démographique des populations d'orignaux infectées et partant, les récoltes possibles par la chasse.

Key words: Meningeal worm, *Parelaphostrongylus tenuis,* Moose, *Alces alces,* White-tailed Deer, *Odocoileus virginianus,* parelaphostrongylosis, population dynamics, Québec.

After Anderson (1964, 1965) experimentally showed that the meningeal worm (*Parelaphostrongylus tenuis*) of White-tailed Deer (*Odocoileus virginianus*) was fatal to Moose (*Alces alces*), it became evident to wildlife ecologists that Moose living in sympatry with deer were at risk from parelaphostrongylosis. Past fluctuations of Moose populations in the south of their range in eastern North America were then related to inverse variations of White-tailed Deer numbers (Karns 1967; Telfer 1967; Anderson 1972; Prescott 1974). During the same period, Telfer (1967) showed that moose and deer exhibited altitudinal segregation related to snow depth during winter in Nova Scotia; the same observation was repeated in adjacent New Brunswick (Kelsall and Prescott 1971). This pattern of habitat segregation provided a plausible explanation for the fact that moose and deer have coexisted in many places in northeastern North America, despite the meningeal worm: some Moose used refugia free of parasites (Telfer 1967; Gilbert 1974; Kearney and Gilbert 1976). However, infection by the meningeal worm occurs during the growing season and habitat segregation in winter does not eliminate the risk of infection for Moose if they share their range with deer during the snow-free period (Nudds 1990).

Recently, Nudds (1990) pointed out that the hypothesis stating that White-tailed Deer caused Moose declines through the effects of meningeal worm had not been tested. He also challenged the existence of refugia that allowed Moose to persist in the presence of infected deer (Gilbert 1992; Nudds 1992). Subsequent reexamination of historical data from eastern North America demonstrated an inverse

relationship between deer and Moose densities, and showed that Moose reached their lowest numbers at deer densities >5•km$^{-2}$ (Whitlaw and Lankester 1994a). In a more detailed study for Ontario, Whitlaw and Lankester (1994b) came to the conclusion that Moose could co-exist with infected deer, in relatively stable numbers, over at least a decade and that Moose numbers were inversely related to the intensity of meningeal worm larvae passed by deer. Whitlaw and Lankester (1994b) concluded that interactions between the two cervids and the nematode were more subtle than previously believed and that further studies were required to evaluate the relative importance of the meningeal worm among limiting factors of Moose populations. For example, the likelihood of transmission to Moose could depend on the age structure of co-habiting deer populations since Slomke et al. (1995) showed that the number of meningeal worm larvae passed by deer was inversely related to deer age.

Along with the renewed interest in the role of the meningeal worm on population dynamics of Moose, Schmitz and Nudds (1994) modelled the Moose-deer-meningeal worm system with differential equations and developed a sensitivity analysis. Model solutions were most sensitive to the competitive effect of Moose on deer, to parasite-induced mortality rate of moose, and to the rate of increase of the intermediate host, three parameters for which there is little empirical information.

The objectives of our study were to census and map the cases of Moose exhibiting signs of parelaphostrongylosis in Québec and to evaluate the role of the meningeal worm in the population dynamics of Moose living in sympatry with White-tailed Deer. We considered two hypotheses concerning the transmission of the meningeal worm from deer to Moose: 1) there exist refugia in which Moose are not infected; as Moose density increases in refugia, animals are progressively forced to disperse out and the proportion of infected individuals increases with Moose density; 2) the probability of Moose infection depends only on deer density. If the first hypothesis were true, then the meningeal worm might regulate Moose populations (sensu Messier 1991); the second scenario implies that the meningeal worm is a limiting factor (sensu Messier 1991), affecting population rate of increase and carrying capacity of the Moose range without any stabilizing effect.

## Study area and methods

The study focused on Moose showing signs of infection caused by the meningeal worm throughout Québec although deer occurred only in the south (Figure 1). The extreme south of Québec is covered by deciduous forests with the exception of agricultural lands and urban areas; highest deer densities (up to 13•km$^{-2}$: F. Potvin and L. Breton, unpublished) occur in this region. Boreal forest, dominated by Black Spruce (*Picea mariana*), Jack Pine (*Pinus banksiana*) and Balsam Fir (*Abies balsamea*), covers northern Québec, beginning around 49°–50° latitude; deer are absent from this biome and Moose density is low (0.05–0.10 animals•km$^{-2}$). In between, mixed forests dominate; deciduous tree species, namely maples (*Acer saccharum*, *A. rubrum*), birches (*Betula alleghaniensis*, *B. papyrifera*) and aspen (*Populus tremuloides*), are progressively replaced northward by conifers. Deer occupy the southern portion of the mixed forests (Figure 1b) at low density (< 3•km$^{-2}$: F. Potvin and L. Breton, unpublished) whereas Moose reach the highest density in this transition zone; i.e., 0.20–0.40 individuals•km$^{-2}$ (Anonymous 1993).

We collected information on symptomatic Moose using a questionnaire distributed to the personnel of the Ministère de l'Environnement et de la Faune throughout Québec, with the exception of the two northernmost regions, which encompassed Anticosti Island. The questionnaire included a summary sheet describing the life cycle of the meningeal worm and listed typical signs of infection in Moose. The first question pertained to the number of cases of symptomatic Moose observed by the respondent during the last year while the second question covered previous years without time limits. For each case, the respondent completed a separate form pertaining to observed signs, location (hunting zone, locality, universal transverse mercator grid locus), date, sex and age class (calf and older) of the animal, and respondent's name and address. The questionnaire was distributed to conservation officers, wildlife technicians and biologists. Most reports were precise in time and space because they were completed by conservation officers who are accustomed to note special events. It was possible to eliminate double reports in all cases. Questionnaires were distributed in June 1992 and returned before March 1993. We did not set a time limit on reported cases, but the analysis focused mostly on the last 10 years, 1983-1992. We assumed that symptomatic Moose suffered from parelaphostrongylosis based on Gilbert (1974), who showed a close agreement between signs and detection of worms in the nervous system of moose.

Apparent infection rate was expressed as the average annual number of cases per 10 000 Moose in winter, taking each hunting zone where symptomatic Moose were observed as a sampling unit (Figure 1a). Moose population sizes were measured from winter aerial census, corrected for visibility bias (Crête et al. 1986); we used the most recent estimates of the five-year census program for monitoring Moose in Québec as Moose densities have been relatively stable during the last decade (Anonymous 1993). Deer density was estimated from the average buck harvest for the study period; i.e., 1983-1992, during which deer populations

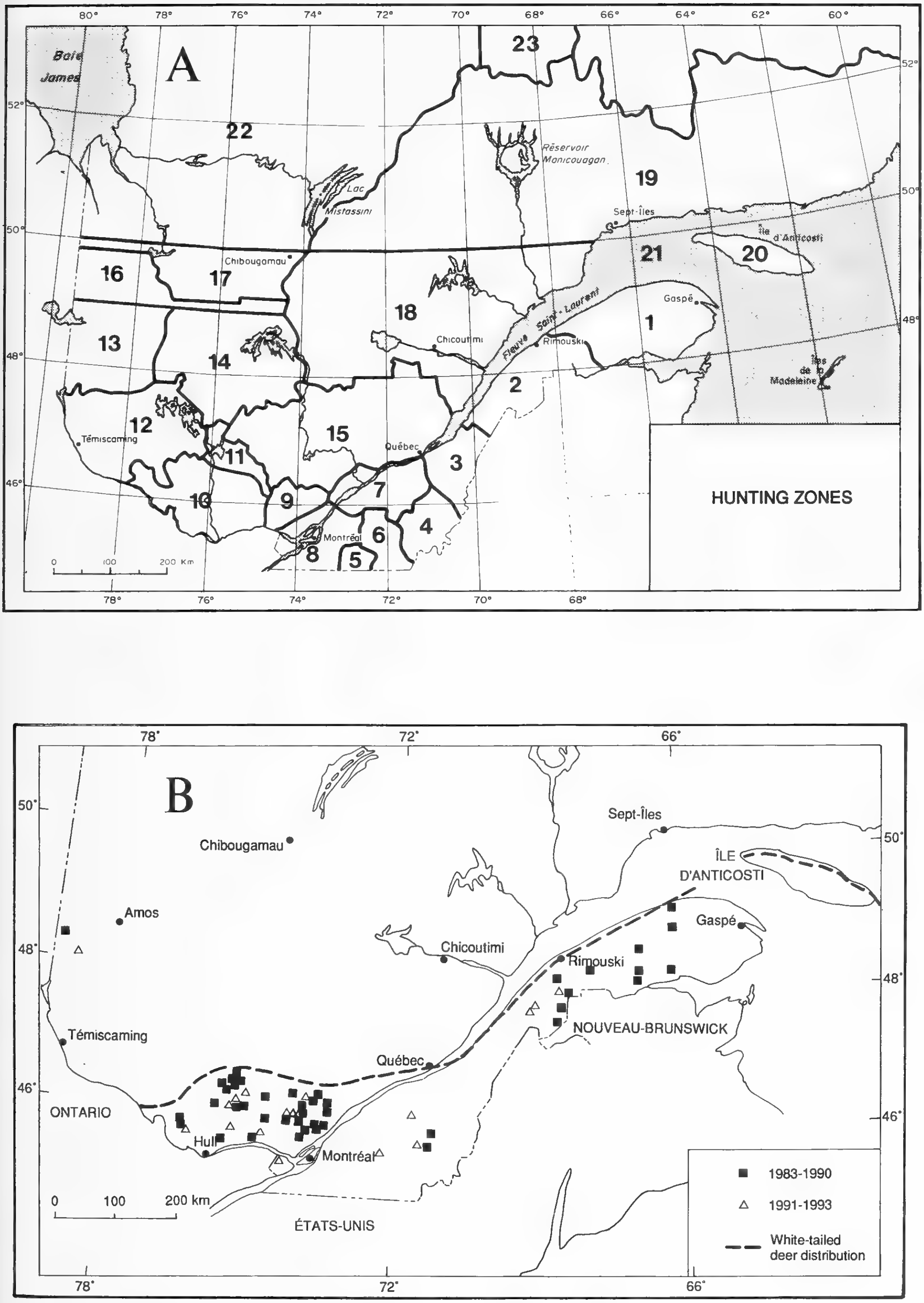


FIGURE 1. (A) Location of current hunting zones in southern Québec; (B) Northern limit of the White-tailed Deer range in winter, and location of reported Moose showing signs of infection by the meningeal worm during the 10-year period 1983-1992.

exhibited strong and variable fluctuations (G. Lamontagne and C. Daigle, unpublished). Registration of hunter-harvested deer is compulsory in Québec. Buck harvests have been used for management purposes in Québec as an index to population size because they have generally paralleled fluctuations in size of deer wintering areas which have been mapped from the air since the mid 1970s.

We used simple and multiple linear regression models for evaluating the strength of the relationships relating apparent infection rate to Moose and deer density (SAS Institute Inc. 1985). The proportion of calves and the sex ratio of symptomatic Moose were compared to the corresponding variables in winter populations with the $\chi^2$ test; for this comparison, we pooled composition counts of all hunting zones where at least 1 infected Moose was reported.

## Results

We received 143 questionnaires that reported 89 different Moose with signs of meningeal worm infection. We deleted five reports coming from Saint-Félicien Zoo (hunting zone 18: Figure1a) where Moose and deer have been kept together in a large forested enclosure. No other cases were reported in this region although most conservation officers there completed the questionnaire.

Since hunting zoning changed in the early 1980s and deer density varied markedly between the 1970s and the 1980s, we kept only those reports from the last 10 years (1983-1992) for further analysis. All but two reports of symptomatic Moose originated from the White-tailed Deer range (Figure 1b). Cases were concentrated in the region to the north and northwest of Montréal, and around Rimouski in eastern Québec. Most reports in the Rimouski area preceded 1990, before the deer population crashed due to a series of harsh winters aggravated by coyote (*Canis latrans*) predation (Crête and Lemieux 1994).

Moose of both sexes appeared equally susceptible to the meningeal worm since the sex ratio among symptomatic animals (40♂60♀; $n$ = 72) did not differ statistically ($\chi^2$ = 2.39, 1 d.f.; $P$ > 0.10) from that observed among living Moose in winter (32♂:68♀; $n$ = 1095). In contrast, calves constituted only 3% of the reported cases ($n$ = 79), which is significantly lower than their percentage in the population (28% ($n$ = 1509); $\chi^2$ = 23.1, d.f. = 1; $P$ < 0.005). The majority of cases (47/82) were concentrated in late winter and spring (March-June) whereas incidence was lowest between August and December (14 cases). Only two symptomatic calves were observed, both in January. The most frequent signs noted were lack of fear of humans, nonchalance, circling movements, and equilibrium loss. In most reports, many signs were observed in an individual animal simultaneously.

The number of reports per 10 000 Moose varied by almost two orders of magnitude between hunting zone 13, where the infection rate was low, and zone 8 where it averaged 37.5 cases – 10 000 moose$^{-1}$ • year$^{-1}$ (Table 1). Apparent infection rate exhibited a positive linear relationship with the index of deer density ( $r^2$ = 0.80; 8 d.f.; $P$ = 0.0004); the addition of Moose density as a second independent variable in a multiple linear regression did not improve the model significantly ($P$ = 0.34). We found no significant relationship between apparent infection rate and Moose density ($r^2$ = 0.25; $P$ = 0.14).

## Discussion

One might question the validity of evaluating the role of the meningeal worm on Moose demography using a questionnaire because such an approach provides semi-quantitive results that can be biased. In particular, animals showing little fear of humans could have been incorrectly recorded as infected moose. This bias, if it existed, must be very small, given the close agreement between reported cases and deer distribution. In this regard, reports from the area of Saint-Félicien Zoo are meaningful: all the cases observed in the zoo where deer and Moose coexist, were declared, whereas the same observers reported no case elsewhere in the region, where only Moose are present. The two cases observed outside of the deer range west of Amos (Figure 1b) could be explained by the presence of deer across the border in Ontario (Whitlaw and Lankester 1994b). Moreover, the decrease in the number of symptomatic Moose reported in southeastern Québec after the deer population crashed also suggests that our monitoring tool of infection was relatively sensitive.

The apparent infection rate could also be biased by differences in road access among hunting zones, in observer:moose ratios, in hunting pressure and in wolf density; infected Moose are most likely vulnerable to hunting or predation. Road access in forested areas of southern Québec has not been measured, but it is relatively good everywhere in the deer range, most of which is private property (Anonymous 1993). North of the deer range, accessibility is generally lower. Hunting pressure for Moose is high everywhere in southern Québec, but the bow is the only weapon allowed in zones 6, 7, 8, 9 and 10 (eastern half)(Anonymous 1993). Wolves (*Canis lupus*) are mostly restricted to the north of the deer range; consequently there could be an underestimation of apparent infection rate in zones 11, 13 and 15 due to predation and road access.

The relationship that we obtained between relative deer density and apparent infection rate of Moose by the meningeal worm suggests that deer abundance constitutes the major risk factor of Moose infection. Deer, most of which harbour meningeal worms in Québec ( Bindernagel and Anderson 1972; Beaulieu-Goudreault 1981; Claveau and Filion 1984), spread larvae in the environment. As deer density increases

TABLE 1. Average annual (1983-1992) apparent rate of Moose infection by the meningeal worm as estimated through a questionnaire, mean Moose density, average deer buck harvest (1983-1992) and actual deer density, for all hunting zones where at least one symptomatic Moose was observed.

| Hunting zone | Infection rate (cases•10 000 moose$^{-1}$) | Moose density (animals•km$^{-2}$) | Deer harvest (buck•10 km$^{-2}$) | Deer density[c] (deer•km$^{-2}$) |
|---|---|---|---|---|
| 1 | 1.4 (5[a]) | 0.18 | 0.35 | 0.02 |
| 2 | 3.6 (9) | 0.22 | 0.47 | 0.27 |
| 3-4-6 | 4.9 (3) | 0.04 | 1.74 | N.A.[d] |
| 7 | 1.5 (1) | 0.17 | 0.90[b] | N.A. |
| 8 | 37.5 (3) | 0.02 | 5.89 | 3.12[e] |
| 9 | 13.4 (13) | 0.22 | 0.89 | 1.17 |
| 10 | 7.2 (21) | 0.16 | 2.54 | 2.88 |
| 11 | 2.2 (1) | 0.11 | 1.73 | 1.89 |
| 13 | 0.4 (2) | 0.23 | 0 | N.A. |
| 15 | 0.6 (3) | 0.10 | 0 | N.A. |

[a] number of reported cases
[b] estimated through the size of deer wintering areas; only bow hunting allowed
[c] estimated from aerial surveys between 1991 and 1995, according to Potvin et al. (1992)
[d] not available
[e] only the portion of the zone located to the south of Fleuve Saint-Laurent

larvae and risk of infection for Moose also increase. Although our sample size is small, our results suggest that the risk of infection was independent of Moose density; our results provide no evidence of refugia for Moose living in sympatry with deer at the scale of Québec hunting zones; i.e., many thousands of square kilometres.

Infection rates of Moose appeared very low. In hunting zone 8 where the rate was the highest, fewer than 1% of Moose were found with signs of parelaphostrongylosis each year. Obviously, many cases passed undetected, and this value may be higher, by an unknown amount. Monitoring of radio-tagged Moose also suggests that paralephostrongylosis is a marginal limiting factor. We monitored, for other purposes, 149 Moose for a total of 73 968 days in two study areas of southern Québec (intersection of zone 10, 11 and 12: Courtois and Crête 1988; Rimouski area: Courtois et al. 1994) where deer density was low. We detected only one case of mortality attributable to the meningeal worm: i.e., an annual mortality rate of 0.5% ± 0.05 (S.E.) (Heisey and Fuller 1985). However, this estimate is also underestimated because Wolves were present in one study area and hunting was allowed in both.

As the infection rate by the meningeal worm was not positively density-dependent, it is unlikely that this parasite regulates Moose populations in southern Québec. When suitable habitat exists, Moose density will mostly depend on forage, predation and hunting (Crête et al. 1981; Messier and Crête 1985; Crête 1989). But the meningeal worm constitutes a limiting factor that diminishes the rate of increase of Moose populations in proportion to deer density. At very high deer density, Moose may be incapable of colonizing deer range. We cannot determine this threshold density because we could not compute an absolute mortality rate caused by the parasite, only an index to it. However, it seems that deer-induced infections cannot exclude Moose from some areas of Québec. Indeed, Moose have persisted on Anticosti Island even with deer densities as high as 15 individuals•km$^{-2}$ (Potvin et al. 1991), which exceeds densities observed elsewhere in southern Québec (G. Lamontagne and C. Daigle, unpublished). Symptomatic Moose have been observed on Anticosti Island (A. Gingras, personal communication). Besides the meningeal worm, other factors could determine the southern limit of the Moose range: quantity and quality of forage in summer and winter (Saether 1985; Crête 1989), competition with White-tailed Deer (Nudds 1990), or thermal stress (Renecker and Hudson 1986).

## Acknowledgments

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# Dietary Flexibility of Shorebirds in the Western Hemisphere

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Skagen, Susan K., and Heather D. Oman. 1996. Dietary flexibility of shorebirds in the western hemisphere. Canadian Field-Naturalist 110(3): 419–444.

Regional patterns of shorebird diets were examined by reviewing 75 papers reporting prey of 43 shorebird species throughout the western hemisphere. Collectively, shorebirds consumed a wide variety of invertebrate taxa, including 12 phyla, 22 classes, 72 orders, 238 families, and 404 genera of invertebrates. The most widely represented invertebrate classes were Insecta, Malacostraca, Gastropoda, Polychaeta, and Bivalvia. The ten most widely studied shorebird species exhibited considerable dietary breadth, consuming an average of 36 (range 23–65) families of invertebrates. Fifteen invertebrate families were common to the diets of seven or more of these ten species. For all shorebird species evaluated, there was little dietary overlap in invertebrate taxa between geographic regions, especially between tidal and inland areas. Diet similarities of species and guilds of shorebirds within regions and of coexisting species within studies were high. The flexible nature of food choice in shorebirds influences management approaches toward providing vital food resources for shorebirds during all seasons. Management efforts should focus on maintaining hydrologic regimes and ecosystem processes that promote the growth and maintenance of invertebrate populations in general; specific taxa need not be targeted. Successful maintenance of wetlands will ensure that naturally-occurring populations of invertebrates occur and are accessible to shorebirds.

Key Words: Shorebirds, Charadriiformes, prey, invertebrates, opportunistic foraging, dietary overlap.

Shorebirds (Charadriiformes; 12 families) are an ecologically diverse group of migratory birds found throughout many regions of the world. Collectively, shorebirds are morphologically diverse, with body lengths ranging from 130 mm to 650 mm and bill lengths ranging from 13 mm to 219 mm (Hayman et al. 1986). Shorebirds occupy a broad array of habitats, including tidal flats, sandy beaches, grass uplands and wet meadows, agricultural fields, and freshwater wetlands (Hayman et al. 1986; Colwell and Oring 1988). They capture a broad spectrum of invertebrates, primarily by gleaning them from the surface of mud, water, and emergent vegetation, or by probing in moist substrates.

Research on shorebird foraging has covered a broad array of topics, including feeding assemblages, niche dimensions, competition, partitioning of habitats, prey selection, and digestive performance (Recher 1966; Baker 1977; Baker and Baker 1973; Connors et al. 1979; Myers et al. 1979a,b; Quammen 1982; Baldassare and Fischer 1984; Gratto et al. 1984; Myers 1984; Colwell and Landrum 1993; Piersma et al. 1993). Information on seasonal and regional patterns of prey choice by shorebirds may lend insight toward the conservation and protection of wetlands that provide critical food resources. The maintenance of healthy viable invertebrate populations is especially important in highly modified landscapes with changing habitat conditions upon which many shorebirds rely, especially during migration (Skagen and Knopf 1993, 1994).

In this paper, we review a sample of data on shorebird diets in the western hemisphere and provide information on the broad spectrum of invertebrates utilized by shorebird species. We examine dietary differences and similarities of species among regions and dietary overlap among co-occurring species. The implications of our findings on wetland management for shorebirds are discussed.

## Methods

A literature search was conducted to compile published papers and documents that report invertebrate prey items used by shorebirds in the western hemisphere. In these papers, prey items consumed by shorebirds were identified by examining stomach/esophageal and gizzard contents, pellets, and fecal droppings, or by directly observing foraging. The studies were inconsistent in presentation of invertebrates consumed, some reporting only orders or families whereas others reported genera or species. We organized invertebrates taxonomically according to Borror and White (1970), Kozloff (1987), Turgeon et al. (1988), Pennak (1989), and Brusca and Brusca (1990), with additional reference to Levi and Levi (1968) and George and George (1979).

We recognize that many potential biases are inherent in a data set combining studies with varying objectives and collection methods. Therefore, no attempt was made to quantify the information beyond occurrence of prey taxa in diets, and dietary similarities were computed based on presence/absence. Basic descriptions of the spectrum of invertebrates in shorebird diets are provided.

The data were divided into eight distinct regions: Pacific (north and south), Interior (north and south),


FIGURE 1. Geographic distribution of 75 scientific studies that reported shorebird diets in the western hemisphere. Parentheses contain the number of studies and the number of shorebird species represented in eight regions during breeding, migration, and wintering periods.

Atlantic (north and south), Gulf of Mexico, and Central/South America (modified from Helmers 1992). North and south divisions occurred at the United States–Canada border (Figure 1). Location of study, time of year, and general habitat type (intertidal or inland wetlands) were also recorded. Shorebird species were grouped according to body size and foraging guild (Table 1; Helmers 1992).

In studies reporting diets of several species in a local area, we calculated similarity indices for pairs of species/guilds based on presence/absence of invertebrate taxa. We also calculated similarity indices to determine dietary overlap in different regions for a given species and for different species within the same region. We used two similarity coefficients, Jaccard [$C_j = j/(a + b - j)$] and Sorenson [$C_s = 2j/(a + b)$], where a = the number of invertebrate taxa consumed by species/guild A, b = the number of invertebrate taxa consumed by species/guild B, and j = the total number of invertebrate taxa common to both species/guilds (Magurran 1988). Values of both indices range from 0 to 1, with 0 indicating dissimilarity and 1 complete similarity.

## Results

We reviewed 75 papers that reported prey items of shorebirds in the western hemisphere. Of these studies, 53% identified prey items by examination of stomach/esophageal and gizzard contents, 24% during foraging observations, 7% by examination of pellets and fecal droppings. Sixteen percent of the papers cited results of other research, and one study determined food items experimentally. We found reference to diets of 43 shorebird species. To further examine patterns of dietary overlap on a larger geographic scale, we reviewed an additional 16 papers on diets of two species in northern Europe that have been widely studied in both the western and eastern hemispheres, the Black-bellied Plover (*Pluvialis squatarola*) and Dunlin (*Calidris alpina*).

TABLE 1. Composition of shorebird guilds based on body size and foraging method (modified after Helmers 1992). Regions of study (see Figure 1) are as follows: AtlN and AtlS (Atlantic coast north and south of the US-Canada border), IntN and IntS (North American interior region north and south of the US-Canada border), PacN and PacS (Pacific coast north and south of the US-Canada border), Gulf (US side of the Gulf of Mexico), and SAm (Central and South America). References are given for studies that report diets. References for two species in NEur (Northern Europe) are given in parentheses.

| Guild | Common and Scientific Names | Regions | References |
|---|---|---|---|
| Plover gleaner | Black-bellied Plover, *Pluvialis squatarola* | AtlN, AtlS, IntN, IntS, PacS, SAm [NEur] | Recher 1966; Baker 1974; Schneider 1978,1983,1985; Hicklin and Smith 1979; Schneider and Harrington 1981; Wishart et al. 1981; Myers 1986; Michaud and Ferron 1990; Helmers 1991; Colwell and Landrum 1993 [Goss-Custard et al. 1977a,b; Evans 1979; Pienkowski 1981, 1983; Zwarts and Drent 1981; Pienkowski et al. 1984; Baird et al. 1985; Evans 1986; Durell and Kelley 1990]. |
| | Lesser Golden Plover, *Pluvialis dominica* | AtlN, IntN, IntS | Brooks 1967b; Baker 1977; Bengston et al. 1978; Wishart et al. 1981; Brown and Harris 1988; Helmers 1991. |
| | Collared Plover, *Charadrius collaris* | SAm | Strauch and Abele 1979. |
| | Snowy Plover, *Charadrius alexandrinus* | IntS, PacS | Reeder 1951; Purdue 1976. |
| | Wilson's Plover, *Charadrius wilsonia* | SAm | Strauch and Abele 1979; Schneider 1983. |
| | Semipalmated Plover, *Charadrius semipalmatus* | AtlN, AtlS, IntN, IntS, Gulf, PacS, SAm | Reeder 1951; Recher 1966; Baker 1973,1977; Hicklin and Smith 1979; Strauch and Abele 1979; Lewis 1983; Schneider 1983; Myers 1986; Michaud and Ferron 1990; Helmers 1991. |
| | Piping Plover, *Charadrius melodus* | AtlN | Shaffer and Laporte 1994. |
| | Killdeer, *Charadrius vociferus* | IntS | Baldwin 1971b; Rundle 1982; Baldassare and Fischer 1984; Helmers 1991; Fair et al. 1995. |
| | Mountain Plover, *Charadrius montanus* | IntS, PacS | Baldwin 1971a. |
| Oyster-catcher prober/prier | American Black Oystercatcher, *Haematopus bachmani* | PacS | Hartwick and Blaylock 1979; Morrell et al. 1979. |
| Small gleaner/prober | Sanderling, *Calidris alba* | AtlS, IntN, IntS, Gulf, PacS, SAm | Reeder 1951; Couch 1966; Danks 1971; Schneider 1978; Gochfeld and Burger 1980; Myers et al. 1979a,1980; Connors et al. 1981; Duffy et al. 1981; Schneider and Harrington 1981; Lewis 1983; Myers 1984,1986,1988; Helmers 1991. |
| | Semipalmated Sandpiper, *Calidris pusilla* | AtlN, AtlS, IntN, IntS, Gulf, PacN, PacS, SAm | Brooks 1967a,b; Holmes and Pitelka 1968; Baker 1973,1977; Harrington and Groves 1977; Ashkenazie and Safriel 1979; Hicklin and Smith 1979,1984; Schneider 1978; Duffy et al. 1981; Schneider and Harrington 1981; Lewis 1983; Gratto et al.1984; Myers 1986; Boates and Smith 1989; Michaud and Ferron 1990; Napolitano and Ackman 1990; Wilson 1990; Helmers 1991; Gratto-Trevor 1992; Colwell and Landrum 1993. |
| | Western Sandpiper, *Calidris mauri* | IntS, PacN, PacS, SAm | Reeder 1951; Couch 1966; Recher 1966; Senner 1979; Duffy et al. 1981; Quammen 1982,1984; Schneider 1983; Baldassare and Fischer 1984; Senner et al. 1989; Helmers 1991; Colwell and Landrum 1993. |

*(Continued)*

TABLE 1. *Continued.*

| Guild | Common and Scientific Names | Regions | References |
|---|---|---|---|
| | Least Sandpiper, *Calidris minutilla* | AtlN, AtlS, IntN, IntS, Gulf, PacS, SAm | Couch 1966; Recher 1966; Brooks 1967a,b; Baker 1973,1977; Hicklin and Smith 1979; Lewis 1983; Schneider 1983; Baldassare and Fischer 1984; Gratto et al. 1984; Myers 1986; Brown and Harris 1988; Helmers 1991; Colwell and Landrum 1993. |
| | Small Baird's Sandpiper, *Calidris bairdii* | IntN, IntS, PacN | Drury 1961; Holmes and Pitelka 1968; Lewis 1983; Baldassare and Fischer 1984; Helmers 1991. |
| | White-rumped Sandpiper, *Calidris fuscicollis* | AtlS, IntN, IntS, SAm | Drury 1961; Lewis 1983; Myers 1986; Helmers 1991; Parmelee 1992. |
| | Purple Sandpiper, *Calidris maritima* | IntN | Danks 1971. |
| Medium gleaner/ prober | Red Knot, *Calidris cantus* | AtlS, IntN, IntS, PacS, Gulf | Sperry 1940; Recher 1966; Myers 1986; Helmers 1991; Colwell and Landrum 1993. |
| | Pectoral Sandpiper, *Calidris melanotos* | IntN, IntS, PacN | Brooks 1967a,b; Pitelka 1959; Holmes and Pitelka 1968; Rundle 1982; Lewis 1983; Helmers 1991. |
| | Dunlin, *Calidris alpina* | AtlS, IntN, IntS, Gulf, PacN, PacS, [NEur] | Couch 1966; Holmes 1966; Recher 1966; Brooks 1967a,b; Holmes and Pitelka 1968; Baker 1973,1977; Senner 1979; Quammen 1982,1984; Buchanan et al. 1985; Myers 1986; Senner et al. 1989; Brennan et al. 1990; Helmers 1991; Colwell and Landrum 1993 [Bengtson and Svensson 1968; Davidson 1971; Bryant 1979; Goss-Custard et al. 1977a,b; Rands and Barkham 1981; Lifjeld 1984; Pienkowski et al. 1984; Baird et al. 1985; Kelsey and Hassall 1989; Durell and Kelly 1990]. |
| | Stilt Sandpiper, *Calidris himantopus* | IntN,IntS | Brooks 1967a,b; Baker 1977; Lewis 1983; Baldassare and Fischer 1984; Helmers 1991. |
| | Short-billed Dowitcher, *Limnodromus griseus* | AtlN, AtlS, IntN, IntS, Gulf, PacS, SAm | Sperry 1940; Reeder 1951; Baker 1973,1977; Schneider 1978,1983,1985; Hicklin and Smith 1979; Mallory and Schneider 1979; Schneider and Harrington 1981; Quammen 1982; Myers 1984,1986; Helmers 1991. |
| | Long-billed Dowitcher, *Limnodromus scolopaceus* | IntN, IntS, PacN, PacS | Sperry 1940; Spawn 1941; Recher 1966; Quammen 1982,1984; Lewis 1983; Baldassare and Fischer 1984; Helmers 1991. |
| | Greater Yellowlegs, *Tringa melanoleuca* | IntS, PacS, SAm | Spawn 1941; Reeder 1951; Brooks 1967a,b; Schneider 1983; Robert and McNeil 1989; Helmers 1991 . |
| | Lesser Yellowlegs, *Tringa flavipes* | IntN, IntS, Gulf, SAm | Spawn 1941; Brooks 1967a,b; Baker 1973, 1977; Lewis 1983; Baldassare and Fischer 1984; Rundle 1982; Robert and McNeil 1989; Michaud and Ferron 1990; Helmers 1991. |
| | Solitary Sandpiper, *Tringa solitaria* | IntS | Helmers 1991. |
| | Willet, *Catoptrophorus semipalmatus* | AtlS, IntN, Gulf, PacS, SAm | Recher 1966; Stenzel et al. 1976; Gochfeld and Burger 1980; Schneider 1983,1985; Myers 1986; Helmers 1991. |
| | Spotted Sandpiper, *Actitis macularia* | SAm | Schneider 1983. |

*(Continued)*

TABLE 1. *Concluded.*

| Guild | Common and Scientific Names | Regions | References |
|---|---|---|---|
| | American Woodcock, *Scolopax minor* | IntN, IntS | Sperry 1940. |
| | Common Snipe, *Gallinago gallinago* | IntS, PacS | Sperry 1940; Spawn 1941; White and Harris 1966; Brooks 1967a,b; Fritzell et al. 1979; Rundle 1982. |
| | Buff-breasted Sandpiper, *Tryngites subruficollis* | IntS | Helmers 1991. |
| Large gleaner/ | Hudsonian Godwit, *Limosa haemastica* | IntN, IntS | Baker 1977; Helmers 1991. |
| prober | Marbled Godwit, *Limosa fedoa* | IntS, PacS | Reeder 1951; Recher 1966; Helmers 1991. |
| | Whimbrel, *Numenius phaeopus* | SAm | Schneider 1983,1985; Velasquez and Navarro 1993. |
| | Long-billed Curlew, *Numenius americanus* | PacS | Stenzel et al. 1976. |
| Turnstone | Ruddy Turnstone, *Arenaria interpres* | AtlS, IntN, Gulf, SAm | Danks 1971; Gochfeld and Burger 1980; Wishart et al. 1981; Schneider 1983,1985; Myers 1986. |
| gleaner/ prober | Black Turnstone, *Arenaria melanocephala* | PacN | Norton et al. 1990. |
| | Surfbird, *Aphriza virgata* | PacN | Norton et al. 1990. |
| Avocet/ Stilt | American Avocet, *Recurvirostra americana* | IntS, PacS | Recher 1966; Hamilton 1975; Quammen 1982,1984; Baldassare and Fischer 1984; Mahoney and Jehl 1985. |
| gleaner/ sweeper | Black-necked Stilt, *Himantopus mexicanus* | IntS, SAm | Hamilton 1975; Robert and McNeil 1989. |
| Phalarope | Wilson's Phalarope, *Phalaropus tricolor* | IntS | Brooks 1967b; Baldassare and Fischer 1984; Mahoney and Jehl 1985; Brown and Harris 1988; Jehl 1988. |
| pelagic gleaner | Northern Phalarope, *Phalaropus lobatus* | IntN, IntS, PacS | Baker 1977; Mercier and Gaskin 1985; Jehl 1986; Brown and Harris 1988. |
| | Red Phalarope, *Phalaropus fulicara* | IntN | Danks 1971; Dodson and Egger 1980. |

The distribution of studies and the numbers of shorebird species represented within regions by season are delineated in Figure 1. Many studies reported results that encompassed several shorebird species or more than one region. The Pacific (north and south), Interior (north and south), and Atlantic (north and south) regions were well represented, cited in 38%, 30%, and 26% of the studies, respectively. Eight studies (11%) were in Central/South America, and only three studies (4%) were conducted in the Gulf of Mexico region. Studies that were conducted during the breeding season were predominately in the Northern Interior region; the majority of studies in the Southern Interior region and in the Atlantic regions were conducted during migration. Diets of wintering birds were recorded primarily in three regions, the Southern Pacific, the Gulf of Mexico, and Central / South America regions.

Invertebrates consumed by western hemisphere shorebirds were taxonomically diverse, representing 12 phyla, 22 classes, 72 orders, 238 families, and 404 genera (Appendix 1). The classes with the most reported taxa were Insecta (phylum Arthropoda, subphylum Uniramia; 117 families and 242 genera), Malacostraca (phylum Arthropoda, subphylum Crustacea; 33 families and 47 genera), Gastropoda (phylum Mollusca; 29 families and 40 genera), Bivalvia (phylum Mollusca; 14 families and 21 genera), and Polychaeta (phylum Annelida; 11 families and 15 genera). The orders containing the most reported taxa were Coleoptera (class Insecta, 33 families and 142 genera), Diptera (class Insecta; 28 families and 28 genera), Hemiptera (class Insecta; 18 families and 31 genera), Decapoda (class Malacostraca; 14 families and 19 genera), Hymenoptera (class Insecta; 11 families and 22 genera), and Amphipoda (class Malacostraca, 9 families and 16 genera).

Seeds were occasionally reported as minor items in shorebird diets, usually comprising less than 5% but occasionally about 10% of prey items (Couch 1966; White and Harris 1966; Baker 1977; Senner 1979; Rundle 1982; Mercier and Gaskin 1985;

TABLE 2. Number of families of invertebrates and number of occurrences (number of families × number of regions in which family occurs) in the diets of ten shorebird species in the western hemisphere. The number of occurrences serves as a coarse index of relative importance of invertebrate orders in shorebird diets. Invertebrate taxon names in parentheses are subclasses. The general habitat type, tidal (T) and inland (I), are denoted.

| Invertebrate Class | Invertebrate Order | Number of Families | Habitat | Shorebird species[1] BBPL | SEPL | SAND | WESA | SESA | LESA | DUNL | SBDO | LEYE | WILL | Total Number of Occurrences | Common Families[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Phylum Sarcodina | (Foraminiferida) | | T | | | | | | | 1 | | | | 1 | |
| Phylum Porifera | | | | | | | | | | | | | | | |
| Demospongiae | (Ceractinomorpha) | 1 | I | | | | | | | | | 1 | | 1 | |
| Phylum Nemertea | | | | | | | | | | | | | | 0 | |
| Anopla | Heteronemertea | 1 | T | 2 | | | | | | | | 1 | | 3 | |
| Phylum Nematoda | | | | | | | | | | | | 1 | | 1 | |
| Phylum Annelida | | | | | | | | | | | | | | | |
| Polychaeta | Orbiniida | 1 | T | 1 | | | | 1 | | | | | | 2 | |
| | Spionida | 1 | T | 1 | | 1 | 2 | 3 | | 1 | 1 | | | 9 | |
| | Cirratulida | 1 | T | | | | | | | | 1 | | 1 | 2 | |
| | Capitellida | 3 | T | | 1 | 2 | 2 | 2 | | 1 | 2 | | 1 | 11 | Capitellidae |
| | Phyllodocida | 4 | T | 5 | 4 | 2 | 2 | 5 | 3 | 1 | 5 | 1 | 2 | 30 | Nereidae |
| | Eunicida | 1 | T | | | | | | | | | | 1 | 1 | |
| | Terebellida | 1 | T | 1 | | | | | | | | | | 1 | |
| | Sabellida | 1 | T | 1 | | | | | 1 | | 1 | | 1 | 4 | |
| Oligochaeta | Haplotaxida | 3 | T,I | 1 | | | 1 | 1 | | 1 | 1 | 1 | | 6 | |
| Phylum Arthropoda | | | | | | | | | | | | | | | |
| Branchiopoda | Anostraca | | I | | | | | 1 | 1 | | | 1 | | 3 | |
| | Cladocera | 1 | I | | | | | | | | | 1 | | 1 | |
| | Conchostraca | | I | | | | | 1 | 1 | | | | | 2 | |
| Maxillopoda | (Copepoda) | | I,T | | | 1 | | 2 | 1 | 1 | | | | 5 | |
| | Harpacticoida | | T | | | | 1 | 1 | | | | | | 2 | |
| | Thoracica | 1 | T | | | | | | | | 1 | | | 1 | |
| | (Ostracoda) | | T,I | | 2 | 2 | 1 | 3 | 1 | 1 | | 1 | 2 | 13 | |
| Phylum Arthropoda | | | | | | | | | | | | | | | |
| Malacostraca | Decapoda | 11 | T | 2 | 6 | 4 | 1 | 3 | 2 | | 1 | 2 | 7 | 28 | |
| | Tanaidacea | 3 | T | | | | | 1 | | 2 | | | 1 | 4 | |
| | Isopoda | 3 | T | | 1 | 3 | 1 | 1 | | 1 | | | | 7 | |
| | Amphipoda | 9 | T | 3 | 2 | 10 | 8 | 7 | 4 | 8 | 2 | 3 | 4 | 51 | Gammaridae Corophiidae |
| | Cumacea | 2 | T | | | | 2 | 1 | 1 | 2 | | | | 6 | |
| Insecta | Collembola | | I | | | | | 1 | | | | | | 1 | |
| | Ephemeroptera | 1 | I | | | | | | | | | 1 | | 1 | |
| | Odonata | 2 | I,T | | 1 | | | | | | | 1 | | 2 | |
| | Homoptera | 3 | I,T | | | 1 | | | | 1 | | 3 | | 5 | |
| | Hemiptera | 10 | I,T | | | 3 | 1 | 2 | 1 | 1 | | 10 | | 18 | |

*Continued*

TABLE 2. *Continued*

| Invertebrate Class | Invertebrate Order | Number of Families | Habitat | Shorebird species[1] BBPL | SEPL | SAND | WESA | SESA | LESA | DUNL | SBDO | LEYE | WILL | Total Number of Occurrences | Common Families[2] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hymenoptera | 6 | I,T | | 2 | 1 | | 1 | 1 | 6 | | 3 | | 14 | |
| | Orthoptera | 1 | I | | | | | | | | | 1 | | 1 | |
| | Diptera | 22 | I,T | 3 | 9 | 4 | 6 | 11 | 7 | 13 | 5 | 18 | 1 | 77 | Chironomidae<br>Tipulidae<br>Ephydridae<br>Dolichopodidae |
| | Coleoptera | 18 | I | 2 | 7 | 5 | 3 | 10 | 6 | 11 | 2 | 19 | | 65 | Carabidae<br>Chrysomelidae |
| | Trichoptera | 2 | I | | | | | | | 1 | | 3 | | 4 | |
| | Lepidoptera | | I | | | | | | | | | 1 | | 1 | |
| Chelicerata | Xiphosura | 1 | T | 1 | 1 | 1 | | 1 | 1 | 1 | | | 1 | 7 | |
| | Araneae | | I | | 1 | 1 | | 1 | | 1 | | 2 | | 6 | |
| | Acari | | T,I | 1 | | | 1 | | | | | 1 | | 3 | |
| Phylum Mollusca | | | | | | | | | | | | | | | |
| Gastropoda | Archaeogastropoda | 1 | T | | 1 | | | | | | | | | 1 | |
| | Mesogastropoda | 5 | T | 3 | 4 | | 2 | 5 | 2 | 3 | 2 | 1 | 4 | 26 | Hydrobiidae |
| | Neogastrapoda | 4 | T | 1 | 3 | | 1 | 2 | 1 | 1 | 1 | | 1 | 11 | Nassariidae |
| | Pyramidellacea | 1 | T | 1 | 2 | | | | | | | | | 3 | |
| | Basommatophora | 1 | I | | | | | 1 | | 1 | | 1 | | 3 | |
| | Archaeopulmonata | 1 | T | | | | | | | | 1 | | | 1 | |
| Bivalvia | Nuculoida | 1 | T | | | | | 1 | | | | | | 1 | |
| | Mytiloida | 1 | T | 1 | | 1 | 1 | 1 | | 2 | 1 | | 1 | 8 | Mytilidae |
| | Veneroida | 6 | T | 5 | 5 | 3 | 6 | 4 | 3 | 5 | 5 | 1 | 5 | 42 | Teilinidae<br>Veneridae |
| | Myoida | 1 | T | 2 | | | 1 | | | 2 | | | 1 | 6 | |
| Phylum Brachiopoda | | | | | | | | | | | | | | | |
| Inarticulata | Atremata | | T,I | | 1 | | | | | | | 1 | | 2 | |
| Phylum Echinodermata | | | | | | | | | | | | | | | |
| Holothurioidea | Apodida | 1 | T | 1 | | | 1 | 1 | | 1 | | | 4 | | |
| Phylum Chordata | | | | | | | | | | | | | | | |
| Osteichthyes | | | | | | 1 | | | | | 1 | | 1 | 3 | |
| Number of regions represented | | | | 6 | 7 | 6 | 4 | 8 | 7 | 6 | 7 | 4 | 5 | | |
| Number of studies | | | | 12 | 11 | 16 | 12 | 22 | 15 | 17 | 13 | 11 | 8 | | |
| Number of invertebrate families in diet | | | | 23 | 38 | 36 | 28 | 37 | 28 | 50 | 27 | 65 | 27 | | |

[1]Codes for shorebird species are as follows. BBPL - Black-bellied Plover, SEPL - Semipalmated Plover, SAND - Sanderling, WESA - Western Sandpiper, SESA - Semipalmated Sandpiper, LESA - Least Sandpiper, DUNL - Dunlin, SBDO - Short-billed Dowitcher, LEYE - Lesser Yellowlegs, WILL - Willet.
[2]Families that occurred in diets of seven or more of the ten shorebird species.

Brown and Harris 1988; Brennan et al 1990; Fair et al. 1995). Seeds were prevalent, however, in the diets of some fall migrants in the interior region (Brooks 1967a; Baldassarre and Fischer 1984), comprising 10-20% of the diets of Common Snipe (*Gallinago gallinago*), Pectoral Sandpipers (*Calidris melanotus*), Least Sandpipers (*C. minutilla*), Western Sandpipers (*C. mauri*), Long-billed Dowitchers (*Limnodromus scolopaceus*), American Avocets (*Recurvirostra americana*), and, in one study (Baldassare and Fischer 1984), nearly 40% of the diet of Stilt Sandpipers (*C. himantopus*).

We summarized the diets of the ten most widely studied species, which represented three foraging guilds, plovers (gleaners), small gleaner/probers, and medium-sized gleaner/probers. We present a coarse index of the relative importance of each invertebrate order in the diet of each of these species; this index is the number of occurrences (the number of invertebrate families multiplied by the number of regions in which the family was reported; Table 2). All ten species exhibited considerable dietary breadth, consuming an average of 36 (range 23–65) families of invertebrates. The invertebrate orders most frequently cited in the diets of these ten species in inland areas were Diptera (primarily chironomid larvae, tipulids, and ephydrids) and Coleoptera (primarily carabid beetles). In intertidal areas, the orders Veneroida (primarily tellinid and venerid clams), Amphipoda (primarily gammarid and corophid amphipods), and Phyllodocida (primarily nereid polychaete worms) were the most often cited (Table 2). There was extensive dietary overlap between these ten species, with 15 families of invertebrates common to the diets of seven or more of the ten species (Table 2). Nereid polychaetes, chironomid larvae, and venerid clams were in the diets of all ten of these shorebird species. Minimal dietary overlap for six of these ten shorebird species occurred between inland and tidal areas; only the insect families Dolichopodidae, Chironomidae, and Corixidae occurred in both inland and tidal areas.

The diet of the Semipalmated Sandpiper (*C. pusilla*) is represented by 22 studies across all eight regions and is the most extensively studied of all shorebird diets. Collectively, this species consumed a wide variety of invertebrates, spanning 25 orders, 37 families, and one additional subclass. Classes with the most families were Insecta (14 families and 2 additional orders), Malacostraca (7 families and one additional order), and Polychaeta (5 families). There was very little overlap in diets between inland and tidal areas in North America and little overlap in taxa consumed in the north Atlantic and south Atlantic regions (Figure 2, Table 3).

Dunlin diets, referenced in 17 studies across six North American regions, spanned 19 orders and 50 families of invertebrates, with two additional subclasses. Insecta (23 families) and Malacostraca (10 families were the most commonly reported food items. Bivalvia was represented by five families, and

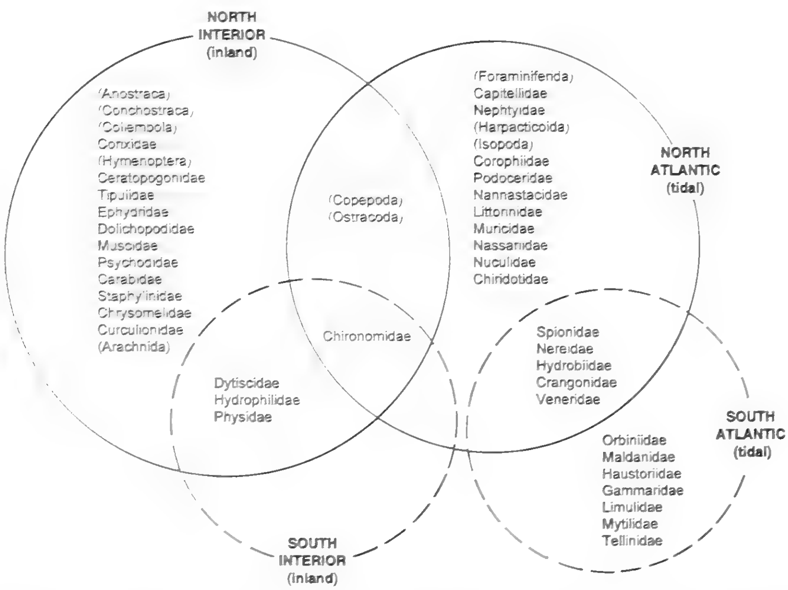


FIGURE 2. Families of invertebrates reported in diets of Semipalmated Sandpipers in four geographic regions. Circles delineate diet overlap among regions. Taxon names in parentheses are orders or subclasses. Data on the North Interior region are from the breeding season and for other regions from migration.

TABLE 3. Similarity coefficients ($C_j$ = Jaccard and $C_s$ = Sorenson; Magurran 1988) for regional pairs for individual species.

| | $C_j$ | $C_s$ |
|---|---|---|
| Semipalmated Plover | | |
| North Atlantic tidal - Central American tidal | 0.09 | 0.16 |
| North Atlantic tidal - North Interior inland | 0.04 | 0.08 |
| North Interior inland - Central American tidal | 0 | 0 |
| South Pacific tidal - Central American tidal | 0.17 | 0.29 |
| Black-bellied Plover | | |
| North Atlantic tidal - South Atlantic tidal | 0.11 | 0.20 |
| South Pacific tidal - South Atlantic tidal | 0.27 | 0.42 |
| South Pacific tidal - Central American tidal | 0.30 | 0.46 |
| Northern Europe tidal - North Atlantic tidal | 0.10 | 0.18 |
| Semipalmated Sandpiper | | |
| North Interior inland - South Interior inland | 0.22 | 0.36 |
| Interior inland - Atlantic tidal | 0.06 | 0.12 |
| North Atlantic tidal - South Atlantic tidal | 0.18 | 0.30 |
| Dunlin | | |
| Pacific tidal - Pacific inland | 0.10 | 0.18 |
| Pacific tidal - Interior inland | 0.05 | 0.10 |
| North Pacific tidal - South Pacific tidal | 0.31 | 0.47 |
| Pacific inland - Interior inland | 0.25 | 0.40 |
| Pacific tidal - Northern Europe tidal | 0.23 | 0.38 |

Polychaeta and Gastropoda by four families each. Dietary overlap between regions and between tidal and inland areas again was minimal (Figure 3).

*Diet similarity and overlap*

We evaluated diet similarity across regions for four species by calculating similarity coefficients

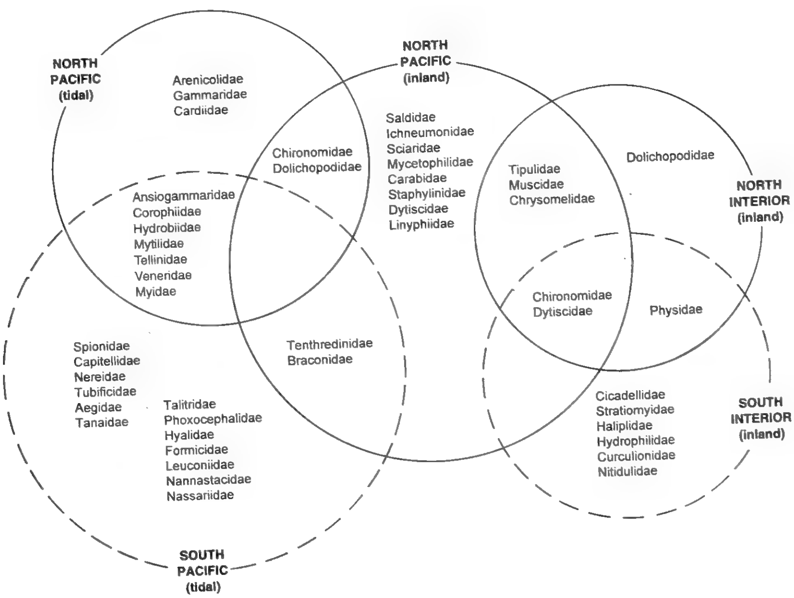


FIGURE 3. Families of invertebrates reported in Dunlin diets in five geographic regions in North America. Circles delineate diet overlap among regions. Taxon names in parentheses are orders or subclasses. Data from the inland North Pacific and North Interior regions are from the breeding season, on the tidal North Pacific and South Interior regions from migration, and the South Pacific from migration and winter.

TABLE 4. Similarity coefficients ($C_j$ = Jaccard and $C_s$ = Sorenson; Magurran 1988) of pairs of species and foraging guilds. Species codes are as follows. SEPL - Semipalmated Plover, BBPL - Black-bellied Plover, SESA - Semipalmated Sandpiper, DUNL - Dunlin.

| | $C_j$ | $C_S$ |
|---|---|---|
| Within-region species pairs, all studies in region | | |
| SEPL - SESA (North Interior, inland) | 0.42 | 0.59 |
| SESA - DUNL (North and South Interior, inland) | 0.35 | 0.51 |
| BBPL - DUNL (Northern Europe, tidal) | 0.32 | 0.48 |
| Within-study species pairs, for comparison | | |
| SEPL - SESA (North Interior, inland; n = 2) | 0.64 | 0.75 |
| SESA - DUNL (North/South Interior, inland; n= 4) | 0.67 | 0.77 |
| BBPL - DUNL (Northern Europe, tidal; n = 4) | 0.59 | 0.74 |
| Means for all within-study pairs | | |
| Species pairs within guilds (n = 29) | 0.51 | 0.62 |
| Guild pairs (n = 28) | 0.55 | 0.67 |

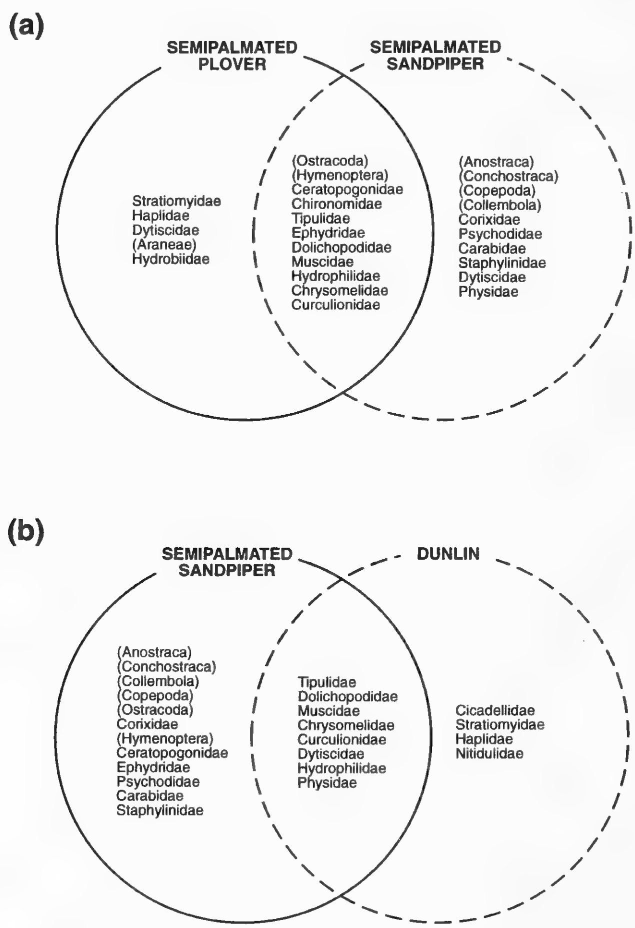


FIGURE 4. (a) Invertebrate families reported in diets of Semipalmated Plovers and Semipalmated Sandpipers in the north Interior inland region. (b) Invertebrate families reported in diets of Semipalmated Sandpipers and Dunlin in north and south Interior inland regions. Circles delineate diet overlap between species. Taxon names in parentheses are orders or subclasses.

based on families (or orders) for pairs of regions. Again, we include dietary information for two of these widely-studied species for northern Europe for additional perspective. There was relatively little overlap in diets between regions (Table 3); $C_j$ values averaged 0.16 and ranged from 0 to 0.31. $C_s$ values were higher, averaging 0.26 and ranging from 0 to 0.47. Similarity coefficients for pairs of the same major habitat type (inland or tidal) were greater than for pairs with contrasting habitat types (average $C_j$ = 0.20 for same and 0.05 for different habitat types).

We also evaluated diet similarities of three pairs of species with sufficient records within the same region (Table 4). There was substantial overlap in diet between Semipalmated Plovers and Semipalmated Sandpipers in the north Interior inland region, and between Semipalmated Sandpipers and Dunlin in the Interior inland regions (Figure 4a,b) and between Black-bellied Plovers and Dunlin in northern Europe. Without exception, similarity indices for the species pairs exceeded the values for species across region pairs, as presented in Table 3. When species occurred within the same study, the diet similarities for the same three species pairs were even greater (Table 4).

In 29 studies including more than one member of a foraging guild, there was substantial diet overlap between species within guilds (Table 4), as indicated by the similarity coefficients, average $C_j = 0.51$ ($\pm$ 0.29 sd, n = 29) and average $C_s = 0.62$ ($\pm$ 0.26 sd, n = 29). In 28 studies with more than one foraging guild represented, diet overlap between guilds was similarly extensive (Table 4), represented by average $C_j = 0.55$ ($\pm$ 0.26 sd, n = 28) and average $C_s = 0.67$ ($\pm$ 0.22 sd, n = 28).

## Discussion

Collectively, shorebird diets span a tremendous breadth of invertebrate taxa. Many shorebird species are euryphagic or cosmopolitan in food choice, and local studies often do not reveal the potential breadth of diet choice for a species across its geographic range. Dietary flexibility allows for the exploitation of variable resources and is highly advantageous to many shorebirds that migrate across vast landscapes and inhabit a variety of wetland types, both inland and tidal, during their yearly cycles.

Patterns of dietary similarity/overlap in shorebirds are also consistent with a flexible foraging strategy. Our analyses showed the greatest dietary similarities between pairs of shorebird species or guilds within a given study; species pairs within a given region were intermediate in diet similarity, and the same species in different regions had the lowest similarity. These findings probably reflect the similarities in food resources within studies and regions and the differences between seasons and regions. The observed patterns of dietary similarities would be expected if shorebirds choose the predominant food items available within each local area.

Several authors have noted the opportunism in shorebirds, especially species in the small and medium sandpiper guilds (Couch 1966; Recher 1966; Holmes and Pitelka 1968; Davidson 1971; Thomas and Dartnell 1971; Gochfeld and Burger 1980; Lewis 1983; Fair et al. 1995). In these studies, opportunism meant taking prey in accordance with its availability (Couch 1966; Recher 1966; Thomas and Dartnall 1971); altering food choice to take advantage of invertebrates available (Davidson 1971), or concentrating where prey is abundant (Holmes and Pitelka 1968). Lewis (1983) and Skagen and Knopf (1993, 1994) emphasized the advantages of flexible, opportunistic strategies for shorebirds that depend on highly unpredictable resources.

Several examples demonstrate that shorebirds combine opportunistic foraging with specific prey selection. Even though many shorebird species are euryphagous, selection for prey type and size has been documented through comparisons of diets of coexisting species (Strauch and Abele 1979; Lifjeld 1984; Senner et al. 1989; Michaud and Ferron 1990) and through comparisons of the abundances of prey items in sediments and in shorebird diets (Holmes 1966; Brooks 1967a; Baker 1977; Bengston et al. 1978; Gratto et al. 1984; Velasquez and Navarro 1993; Fair et al. 1995). Redshanks (*Tringa totanus*) selected for polychaete size only when the preferred size was abundant (Goss-Custard 1977a). In another study, Redshanks selected amphipods above a threshold size relative to their proportion in the substrate (Goss-Custard 1969). Morrell et al. (1979) proposed that diets of Black Oystercatchers (*Haematopus bachmani*) are determined primarily by prey availability and only secondarily by distinct preferences for prey type. Brooks (1967a) and Holmes (1966) found birds selecting a few preferred items and taking other foods relative to their availability in the substrate, and Schneider (1978) reported the selective removal of numerically dominant invertebrate species.

Species and foraging guilds substantially overlap in diet within a geographic region and within a local study area. Even in light of reported dietary differences, many authors commented on the high degree of dietary overlap among coexisting species (Couch 1966; Recher 1966; Holmes and Pitelka 1968; Baker 1977; Hicklin and Smith 1979; Senner et al. 1989; Baldassarre and Fischer 1984; Lifjeld 1984; Brown and Harris 1988; Michaud and Ferron 1990). Extensive dietary overlap may occur if coexisting species forage opportunistically on a limited number of invertebrate taxa in a small area (Holmes and Pitelka 1968).

Dietary overlap based on invertebrate taxonomy at the family level, as discussed here, does not necessarily reflect a lack of ecological segregation. Niche separation may be achieved as a result of behavioral differences or use of different substrates or micro-

habitats (Drury 1961; Recher 1966; Bengtson and Svensson 1968; Thomas and Dartnall 1971; Baker and Baker 1973; Baker 1977; Connors et al. 1979; Senner et al. 1989; Strauch and Abele 1979; Quammen 1982; Lewis 1983; Baldassare and Fischer 1984; Grant 1984; Helmers 1991). For example, habitat partitioning based on tide cycles, substrate, microhabitat features, and water depth is well documented (Recher 1966; Brooks 1967a; Burger et al. 1977; Colwell and Oring 1988; Helmers 1991; Colwell and Landrum 1993).

The flexible nature of food choice in shorebirds has important implications for the management and restoration of wetland habitats. Because shorebirds utilize a broad range of invertebrate taxa, efforts to maintain vital food resources for shorebirds during all seasons should focus on maintaining hydrologic regimes and ecosystem processes that promote the growth and maintenance of invertebrate populations in general. Particular invertebrate taxa need not be targeted. Wetland management, restoration, and creation that enhances naturally-occurring populations of invertebrates will undoubtedly be successful if the invertebrates are accessible to shorebirds.

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APPENDIX 1. Taxonomic context of invertebrate prey items reported in 75 studies of shorebird diets in the western hemisphere.

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Sarcomastigophora | Sarcodina | Granuloreticulosa | Foraminiferida | | | | foraminiferans |
| Porifera | | Demospongiae | Ceractinomorpha | Haplosclerida | Spongillidae | | freshwater sponges |
| Nemertea | | Anopla | | Heteronemertea | Lineidae | *Cerebratulus* | proboscis worms |
| Nematoda | | | | | | | roundworms |
| Cnidaria | | Hydrozoa | | Hydroidea | | | hydra |
| Annelida | | Oligochaeta | | Haplotaxida | Lumbricidae | *Lumbricus* | earthworm |
| | | | | | | *Allolobophora* | |
| | | | | | Tubificidae | *Limnodriloides* | |
| | | Polychaeta | | Capitellida | Arenicolidae | *Arbarenicola* | lugworms |
| | | | | | Capitellidae | *Capitella* | |
| | | | | | | *Heteromastus* | |
| | | | | | | *Notomastus* | |
| | | | | | Maldanidae | *Clymenella* | bamboo worms |
| | | | | Cirratulida | Cirratulidae | *Cirriformia* | |
| | | | | Eunicida | Lumbrineridae | *Lumbrineris* | |
| | | | | Opheliida | Opheliidae | | |
| | | | | Orbiniida | Orbiniidae | *Scoloplos* | sand worms |
| | | | | Phyllodocida | Glyceridae | *Glycera* | |
| | | | | | Nephtyidae | *Nephthys* | |
| | | | | | Nereidae | *Neanthes* | |
| | | | | | | *Nereis* | king ragworms |
| | | | | | | *Perinerius* | |
| | | | | Spionida | Spionidae | *Streblospio* | |
| | | | | | | *Polydora* | |
| | | Hirudinida | Hirudinea | | Herpobdellidae | *Herpobdella* | leeches |
| Brachiopoda | | Inarticulata | | Atremata | — | *Lingula* | lamp shells |
| Bryozoa | | Phylactolaemata | | Plumatellida | Plumatellidae | *Plumatella* | bryozoans |
| Mollusca | | Gastropoda | Opisthobranchia | Cephalaspidea | Retusidae | *Odostomia* | barrel-bubbles |
| | | | | | | *Retusa* | |
| | | | | | | *Sayella* | |
| | | | | | Scaphandridae | *Acteocina* | channel barrel-bubbles |
| | | | | Pyramidellacea | Pyramidellidae | *Turbonilla* | |
| | | | Prosobranchia | Archaeogastropoda | Lottiidae | *Lottia* | limpets |
| | | | | | Neritidae | *Neritina* | nerites |
| | | | | | Patellidae | *Collisella* | limpets |
| | | | | Mesogastropoda | Hydrobiidae | *Amnicola* | mud amnicola |
| | | | | | | *Fontigens* | |
| | | | | | | *Hydrobia* | snails |
| | | | | | | *Tryonia* | snails |

*Continued*

APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Mollusca | | Gastropoda | Prosobranchia | Mesogastropoda | Cerithiidae | *Bittium* | |
| | | | | | | *Diastoma* | |
| | | | | | Cerithiopsidae | *Seila* | |
| | | | | | Lacunidae | *Lacuna* | lacuna |
| | | | | | Littorinidae | *Littorina* | periwinkles |
| | | | | | Naticidae | | moonshells |
| | | | | | Potamididae | *Cerithidea* | horn shells |
| | | | | | Rissoidae | *Cingula* | |
| | | | | | Skeneopsidae | *Skeneopsis* | skenea |
| | | | | | Valvatidae | *Valvata* | three ridge valvata |
| | | | | Neogastropoda | Buccinidae | *Buccinum* | whelk |
| | | | | | Columbellidae | *Anarchis* | greedy dove snail |
| 1 | | | | | | *Mitrella* | lunar dove snail |
| | | | | | Marginellidae | | |
| | | | | | Muricidae | *Nucella* | dogwhelks |
| | | | | | Nassariidae | *Ilyanassa* | mud snails |
| | | | | | | *Nassarius* | nassa |
| | | | | | Naticidae | *Polinices* | moon snails |
| | | | | | Olividae | *Olivella* | |
| | | | | | Turridae | *Mangelia* | |
| | | | Pulmonata | Archaeopulmonata | Melampodidae | *Melampus* | melampus |
| | | | | | | *Phytia* | |
| | | | | | Ellobiidae | *Melampus* | |
| | | | | Basommatophora | Lymnaeidae | *Fossaria* | goldon fossoria |
| | | | | | | *Lymnaea* | freshwater limpets |
| | | | | | | *Stagnicola* | |
| | | | | | Physidae | *Physa* | pouch snails |
| | | | | | Planorbidae | *Gyraulus* | ash gyro |
| | | | | | | *Helisoma* | two ridge rams horn |
| | | | | | | *Planorbis* | thick lip rams horn |
| | | Bivalvia | Protobranchia | Nuculoida | Nuculidae | *Nucula* | nutclam |
| | | | Lamellibranchia | Arcoida | Arcidae | *Anadara* | ark shells |
| | | | | Myoida | Myidae | *Mya* | softshells |
| | | | | | | *Cryptomya* | |
| | | | | Mytiloida | Mytilidae | *Mytilus* | mussels |
| | | | | | | *Modiolus* | horse mussel |
| | | | | Ostreoida | Pectinidae | *Pecten* | scallops |
| | | | | | Ostreidae | *Ostrea* | oyster |
| | | | | Veneroida | Astartidae | *Astarte* | astarte |
| | | | | | Cardiidae | *Clinocardium* | cockles |

*Continued*

APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Mollusca | | Bivalvia | Lamellibranchia | Veneroida | Cultellidae | *Siliqua* | |
| | | | | | Donacidae | *Donax* | wedge shells |
| | | | | | Mactridae | *Mulinia* | dwarf surf clam |
| | | | | | Sphaeriidae | *Pisidium* | pea clam |
| | | | | | Tellinidae | *Macoma* | clams |
| | | | | | | *Tellina* | |
| | | | | | Veneridae | *Gemma* | gem clams |
| | | | | | | *Parastarte* | brown gem clam |
| | | | | | | *Protothaca* | |
| | | | | | | *Transenella* | clams |
| | | | | | | *Venus* | hardshelled clam |
| Arthropoda | Crustacea | Branchiopoda | | Anostraca | Artemiidae | *Artemia* | fairy brine shrimp |
| | | | | Cladocera | Daphnidae | *Moina* | water fleas |
| | | | | | | *Daphnia* | |
| | | | | | | *Eurycercus* | cladocerans |
| | | | | | | *Chydorus* | |
| | | | | Conchostraca | | | clam shrimp |
| | | Maxillopoda | Cirripedia | Thoracica | Scalpellidae | *Mitella* | barnacles |
| | | | Copepoda | Harpacticoida | | | copepods |
| | | | | Cyclopoida | Cyclopidae | | cyclopoids |
| | | | | Calanoida | Diaptomidae | *Diaptomus* | calanoid copepods |
| | | | | | | *Acartia* | |
| | | | | | Centropogidae | *Centropages* | |
| | | | | | | *Pseudocalanus* | |
| | | | | | Temoridae | *Eurytemora* | |
| | | | | | | *Tortanus* | |
| | | | Ostracoda | | Cyprididae | *Cyclocypris* | ostracods, seed shrimp |
| | | Malacostraca | Eumalacostraca | Decapoda | Astacidae | *Cambarus* | crawfish |
| | | | | | Ocypodidae | | fiddler crabs |
| | | | | | Callianassidae | *Callianassa* | ghost shrimp |
| | | | | | Canceridae | *Cancer* | true crabs |
| | | | | | | *Carcinus* | |
| | | | | | Caridae | *Palaemon* | |
| | | | | | Crangonidae | *Crangon* | shrimp |
| | | | | | Grapsidae | *Hemigrapsus* | mud crabs |
| | | | | | | *Pachygrapsus* | shore crabs |
| | | | | | Hippidae | *Emerita* | sand crabs |
| | | | | | Lithodidae | *Oedignathus* | |
| | | | | | Ocypodidae | *Eurypanopeus* | |
| | | | | | | *Speocarcinus* | |

*Continued*

APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Crustacea | Malcostraca | | Decapoda | Ocypodidae | *Uca* | fiddler crabs |
| | | | | | Paguridae | *Paguristes* | |
| | | | | | | *Pagurus* | |
| | | | | | Penaeidae | *Penaeus* | |
| | | | | | Portunidae | *Callinectes* | blue crabs |
| | | | | | Upogebiidae | *Upogebia* | mud shrimp |
| | | | | | Xanthidae | *Eriphia* | |
| | | | | | | *Panopeus* | |
| | | | Pericarida | Amphipoda | Ampithoidae | *Ampithoe* | sandhoppers |
| | | | | | Ansiogammaridae | *Ansiogammarus* | |
| | | | | | Corophiidae | *Corophium* | |
| | | | | | Gammaridae | *Gammarus* | |
| | | | | | | *Echinogammarus* | |
| | | | | | Haustoriidae | *Acanthohaustorius* | |
| | | | | | | *Eohaustorius* | |
| | | | | | | *Protohaustaurius* | |
| | | | | | | *Trichophoxus* | |
| | | | | | Hyalidae | *Allorchestes* | |
| | | | | | Phoxocephalidae | *Paraphoxus* | |
| | | | | | Podoceridae | *Dulichia* | |
| | | | | | Talitridae | *Hyalella* | beach fleas |
| | | | | | | *Orchestia* | beach fleas |
| | | | | | | *Orchestoidea* | beach fleas |
| | | | | | | *Traskiana* | |
| | | | | Cumacea | Leuconiidae | *Leucon* | |
| | | | | | Nannastacidae | *Campylaspis* | |
| | | | | | | *Leptocuma* | |
| | | | | | | *Oxyurostylis* | |
| | | | | Isopoda | Aegidae | *Rocinela* | |
| | | | | | Anthuridae | *Cyathura* | |
| | | | | | Asellidae | *Asellus* | |
| | | | | | Cirolanidae | *Excirolana* | aquatic sow bugs |
| | | | | | Idoteidae | *Ancinus* | |
| | | | | | Sphaeromidae | *Exosphaeroma* | |
| | | | | Tanaidacea | Paratanaidae | *Leptochelia* | |
| | | | | | Tanaidae | *Pancolus* | seed shrimp |
| | Uniramia | Insecta | Apterygota | Collembola | | | springtails |
| | | | Pterygota | Ephemeroptera | Baetidae | *Callibaetis* | baetid mayflies |
| | | | | Orthoptera | Acrididae | | grasshoppers |
| | | | | | Gryllacrididae | *Ceuthophilus* | camel crickets |

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APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uniramia | Insecta | Pterygota | Orthroptera | Gryllidae | *Gryllus* | crickets |
| | | | | | Tetrigidae | *Tettix* | rouse locusts |
| | | | | | Tettigoniidae | | long-horned grasshoppers |
| | | | | Blattaria | Blattidae | | cockroaches |
| | | | | Odonata | Aeshnidae | *Anax* | darker dragonflies |
| | | | | | Coenagrionidae | *Enallagma* | narrow-winged damselflies |
| | | | | | Libellulidae | *Epicordulia* | dragonflies |
| | | | | | | *Erythemis* | |
| | | | | | | *Plathemis* | |
| | | | | Plecoptera | | | stoneflies |
| | | | | Mallophaga | Menoponidae | *Colpocephalum* | bird lice |
| | | | | | Philopteridae | *Degeeriella* | |
| | | | | Thysanoptera | | | thrips |
| | | | | Hemiptera | Anthocoridae | | flower bugs |
| | | | | | Belostomatidae | *Belostoma* | giant water bugs |
| | | | | | Coreidae | *Aufeius* | leaf-footed bugs |
| | | | | | | *Corizus* | leaf-footed bugs |
| | | | | | Corimelaenidae | | negro bugs |
| | | | | | Corixidae | *Arctocorixa* | water boatmen |
| | | | | | | *Corixa* | |
| | | | | | | *Palmacorixa* | |
| | | | | | | *Trichocorixa* | |
| | | | | | Cydnidae | *Pangaeus* | burrowing bugs |
| | | | | | | *Galgupha* | |
| | | | | | Gerridae | *Gerris* | water striders |
| | | | | | Lygaeidae | *Cymus* | seed bugs |
| | | | | | | *Geocoris* | |
| | | | | | | *Nysius* | |
| | | | | | | *Peritrechus* | |
| | | | | | Mesoveliidae | *Mesovelia* | mesoveliids |
| | | | | | Miridae | | plant bugs |
| | | | | | Nabidae | *Nabis* | damsel bugs |
| | | | | | Naucoridae | *Pelocoris* | creeping water bugs |
| | | | | | Notonectidae | *Plea* | back swimmers |
| | | | | | Pentatomidae | *Apateticus* | stink bugs |
| | | | | | | *Banasa* | |
| | | | | | | *Chlorochroa* | |
| | | | | | | *Elasmostethus* | |
| | | | | | | *Euschistus* | |
| | | | | | | *Menecles* | |

*Continued*

APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uniramia | Insecta | Pterygota | Hemiptera | Pentatomidae | *Peribalus* | |
| | | | | | | *Thyanta* | |
| | | | | | | *Zicrona* | |
| | | | | | Saldidae | *Chiloxanthus* | shore bugs |
| | | | | | | *Pentacora* | |
| | | | | | | *Saldula* | |
| | | | | | Veliidae | | water striders |
| | | | | | Tingidae | *Piesma* | lacebugs |
| | | | | Homoptera | Aphididae | | plant lice |
| | | | | | Cercopidaae | *Aphrophora* | spittle insects |
| | | | | | Cicadellidae | *Agallia* | leafhoppers |
| | | | | | | *Cuerna* | |
| | | | | | | *Draeculacephala* | |
| | | | | | | *Xerophloea* | |
| | | | | | Cixiidae | *Cixius* | cixiid planthoppers |
| | | | | | | *Liburnia* | |
| | | | | | Fulgoridae | | fulgorid planthoppers |
| | | | | | Membracidae | | tree hoppers |
| | | | | Trichoptera | Limnephilidae | *Grensia* | northern case-makers |
| | | | | | Brachycentridae | *Micrasema* | humpless case-makers |
| | | | | | Leptoceridae | | long-horned caddisflies |
| | | | | | Limnephilidae | | caddisflies |
| | | | | Lepidoptera | Geometridae | | geometrid moths |
| | | | | | Hesperiidae | | skippers |
| | | | | | Noctuidae | | owlet moths |
| | | | | | Pyralidae | | pyralid moths |
| | | | | | Tortricidae | | tortricid moths |
| | | | | Diptera | Anthomyiidae | | anthomyiid flies |
| | | | | | Asilidae | | robber flies |
| | | | | | Bombyliidae | | bee flies |
| | | | | | Sphaeroceridae | *Leptocera* | small dung flies |
| | | | | | | *Sphaerocera* | |
| | | | | | Ceratopogonidae | *Palpomyia* | biting gnats |
| | | | | | | *Probezzia* | |
| | | | | | | *Ceratopogon* | |
| | | | | | Chironomidae | *Chironomus* | midges and non-biting gnats |
| | | | | | | *Palpomyia* | |
| | | | | | Chloropidae | *Meromyza* | fruit flies |
| | | | | | Clusiidae | | clusiid flies |
| | | | | | Culicidae | | mosquitos |

*Continued*

APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uniramia | Insecta | Pterygota | Diptera | Dolichopodidae | *Sarcionus* | long-legged flies |
| | | | | | Empididae | | dance flies |
| | | | | | Ephydridae | *Ephydra* | shore flies/brine flies |
| | | | | | Muscidae | *Limnophora* | muscid flies |
| | | | | | | *Lispe* | |
| | | | | | Mycetophilidae | | fungus gnats |
| | | | | | Ortitidae | | picture-winged flies |
| | | | | | Psychodidae | *Pericoma* | moth flies |
| | | | | | Ptychopteridae | | phantom crane flies |
| | | | | | Rhagionidae | | snipe flies |
| | | | | | Sarcophagidae | *Lucilia* | flesh flies |
| | | | | | Sciaridae | *Sciara* | dark-winged fungus gnats |
| | | | | | Stratiomyidae | *Odontomyia* | soldier flies |
| | | | | | | *Stratiomyia* | |
| | | | | | Syrphidae | *Eristalis* | flower flies |
| | | | | | | *Sphaerophoria* | |
| | | | | | Tabanidae | *Chrysops* | horse flies, deer flies |
| | | | | | | *Tabanus* | tabanus |
| | | | | | Tachinidae | | tachinids |
| | | | | | Therevidae | | stiletto flies |
| | | | | | Tipulidae | *Limnophila* | crane flies |
| | | | | | | *Pedicia* | |
| | | | | | | *Prionocera* | |
| | | | | | | *Tipula* | |
| | | | | | Xylophagidae | | xylophagid flies |
| | | | | Hymenoptera | Formicidae | *Aphaenogaster* | ants |
| | | | | | | *Camponotus* | |
| | | | | | | *Creamatogaster* | |
| | | | | | | *Formica* | |
| | | | | | | *Lasius* | |
| | | | | | | *Monomorium* | |
| | | | | | | *Myrmica* | |
| | | | | | | *Pogonomyrmex* | |
| | | | | | | *Ponera* | |
| | | | | | | *Solenopsis* | |
| | | | | | | *Tapinoma* | |
| | | | | | Ichneumonidae | *Amblyteles* | Ichneumon wasps |
| | | | | | | *Itoplectis* | |
| | | | | | | *Mesochorus* | |
| | | | | | | *Phaeogones* | |

*Continued*

APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uniramia | Insecta | Pterygota | | | *Plesignathus* | |
| | | | | | | *Pterocormus* | |
| | | | | | Pompilidae | | spider wasps |
| | | | | | Proctotrupidae | *Proctotrupes* | proctotrupids |
| | | | | | Tenthredinidae | | sawflies |
| | | | | | Ceraphronidae | | |
| | | | | | Chalcididae | *Spilochaleis* | chalcidid wasps |
| | | | | | Braconidae | *Meteorus* | braconid wasps |
| | | | | | | *Chelonus* | |
| | | | | | Halictidae | *Halictus* | andrenids |
| | | | | | Sphecidae | | sphecid wasps |
| | | | | | Cynipidae | | gall wasps |
| | | | | Neuroptera | Ascalaphidae | | ascalaphids |
| | | | | | Corydalidae | *Corydalis* | dobson flies |
| | | | | | | *Chauliodes* | fish flies |
| | | | | Coleoptera | Anthicidae | *Anthicus* | ant-like flower beetles |
| | | | | | Alleculidae | *Capnochroa* | comb-clawed bark beetle |
| | | | | | Buprestidae | | metallic woodboring beetles |
| | | | | | Byrrhidae | *Cytilus* | pill beetles |
| | | | | | Cantharidae | *Canthris* | soldier beetles |
| | | | | | Carabidae | *Agonoderus* | ground beetles |
| | | | | | | *Amara* | |
| | | | | | | *Anadaptus* | |
| | | | | | | *Anisodactylus* | |
| | | | | | | *Bembidion* | |
| | | | | | | *Chlaenuius* | |
| | | | | | | *Clivina* | |
| | | | | | | *Cratacanthus* | |
| | | | | | | *Cryobius* | |
| | | | | | | *Dicoderus* | |
| | | | | | | *Elaphrus* | |
| | | | | | | *Euryderus* | |
| | | | | | | *Harpalus* | |
| | | | | | | *Micromaseus* | |
| | | | | | | *Oodes* | |
| | | | | | | *Patrobus* | |
| | | | | | | *Piosoma* | |
| | | | | | | *Platynus* | |
| | | | | | | *Poecilus* | |
| | | | | | | *Pseudargutor* | |

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APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uriramia | Insecta | Pterygota | Coleoptera | Carabrdae | *Pterostichus* | |
| | | | | | | *Stenolophus* | |
| | | | | | | *Trechus* | |
| | | | | | | *Triliarthrus* | |
| | | | | | Cerambicidae | | long horned beetles |
| | | | | | Chrysomelidae | *Calligrapha* | leaf beetles |
| | | | | | | *Chrysomela* | |
| | | | | | | *Colaspis* | |
| | | | | | | *Coptocycla* | |
| | | | | | | *Donacia* | |
| | | | | | | *Glyptina* | |
| | | | | | | *Graphops* | |
| | | | | | | *Altica* | |
| | | | | | | *Lema* | |
| | | | | | | *Myochrous* | |
| | | | | | | *Oedionichis* | |
| | | | | | | *Orthaltica* | |
| | | | | | | *Orsodaene* | |
| | | | | | | *Rhabolopterus* | |
| | | | | | | *Stenopodius* | |
| | | | | | | *Systena* | |
| | | | | | Cicindelidae | *Cicindela* | tiger beetles |
| | | | | | Cleridae | *Enoclerus* | checkered beetles |
| | | | | | Coccinellidae | *Hyperaspis* | ladybugs |
| | | | | | | *Ceratomegilla* | |
| | | | | | Cucujidae | | flat bark beetles |
| | | | | | Curculionidae | *Anthonomus* | weevils |
| | | | | | | *Bracyrhinus* | |
| | | | | | | *Calyptillus* | |
| | | | | | | *Ceutorhynchus* | |
| | | | | | | *Elassopres* | |
| | | | | | | *Epicaerus* | |
| | | | | | | *Gerstaeckeria* | |
| | | | | | | *Hypera* | |
| | | | | | | *Hyperodes* | |
| | | | | | | *Limnobaris* | |
| | | | | | | *Listronotus* | |
| | | | | | | *Lixus* | |
| | | | | | | *Ophryastes* | |
| | | | | | | *Pantomorus* | |

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APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uniramia | Insecta | Pterygota | Coleoptera | Curculionidae | *Sitona* | |
| | | | | | | *Smicronyx* | |
| | | | | | | *Sphenophorus* | |
| | | | | | | *Stenophorus* | |
| | | | | | | *Thecesternus* | |
| | | | | | | *Thyloderma* | |
| | | | | | Dermestidae | | dermestid beetles |
| | | | | | Dytiscidae | *Acilius* | predaceous diving beetles |
| | | | | | | *Agabus* | |
| | | | | | | *Canthydrus* | |
| | | | | | | *Coelambus* | |
| | | | | | | *Colymbetes* | |
| | | | | | | *Copelatus* | |
| | | | | | | *Coptotomus* | |
| | | | | | | *Dysticus* | |
| | | | | | | *Graphoderus* | |
| | | | | | | *Hydaticus* | |
| | | | | | | *Hydrocanthus* | |
| | | | | | | *Hygrotus* | |
| | | | | | | *Hydroporus* | |
| | | | | | | *Ilybius* | |
| | | | | | | *Laccophilus* | |
| | | | | | | *Matus* | |
| | | | | | | *Rhantus* | |
| | | | | | | *Thermonectes* | |
| | | | | | Elateridae | *Agriotes* | click beetles |
| | | | | | | *Athous* | |
| | | | | | | *Dolopius* | |
| | | | | | | *Drasterius* | |
| | | | | | | *Limonius* | |
| | | | | | | *Orthostethus* | |
| | | | | | Haliplidae | *Haliplus* | crawling water beetles |
| | | | | | | *Peltodytes* | |
| | | | | | Elmidae | *Heterelmis* | riffle beetles |
| | | | | | | *Stenelmis* | |
| | | | | | Ptilodactylidae | *Ptilodactyla* | ptilodactylids |
| | | | | | Heteroceridae | *Heterocerus* | variegated mudloving beetles |
| | | | | | Histeridae | *Aphelosternus* | hister beetles |
| | | | | | | *Hister* | |
| | | | | | | *Spilodiscus* | |

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APPENDIX 1. *Continued.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uniramia | Insecta | Pterygota | Coleoptera | Hydrophilidae | *Berosus* | water scavenger beetles |
| | | | | | | *Cercyon* | |
| | | | | | | *Cymbiodyta* | |
| | | | | | | *Devallus* | |
| | | | | | | *Enochrus* | |
| | | | | | | *Helochares* | |
| | | | | | | *Helophorus* | |
| | | | | | | *Hydrobius* | |
| | | | | | | *Hydrophilus* | |
| | | | | | | *Laccobius* | |
| | | | | | | *Ochthebius* | |
| | | | | | | *Tropisternus* | |
| | | | | | | *Sphaeridium* | |
| | | | | | | *Tropisternus* | |
| | | | | | Lucanidae | *Platycerus* | stag beetles |
| | | | | | Melyridae | | soft-winged flower beetles |
| | | | | | Nitidulidae | *Carpophilus* | picnic beetles |
| | | | | | | *Glischrochilus* | sap beetles |
| | | | | | Phalacridae | *Phalacrus* | shining flower beetles |
| | | | | | Scarabaeidae | *Aphodius* | |
| | | | | | | *Canthon* | scarab beetles, june bugs |
| | | | | | | *Cotinus* | |
| | | | | | | *Dyseinetus* | |
| | | | | | | *Euphoria* | |
| | | | | | | *Onthophagus* | |
| | | | | | | *Phyllophaga* | |
| | | | | | | *Rhyssemus* | |
| | | | | | Scolytidae | | bark beetles |
| | | | | | Silphidae | | carrion beetles |
| | | | | | Staphylinidae | *Bledius* | rove beetles |
| | | | | | | *Cafius* | |
| | | | | | | *Cyrohyphus* | |
| | | | | | | *Lathiobium* | |
| | | | | | | *Micralymna* | |
| | | | | | | *Omalium* | |
| | | | | | | *Philonthus* | |
| | | | | | | *Quedius* | |
| | | | | | | *Staphylinus* | |
| | | | | | | *Sjtilicus* | |
| | | | | | Tenebrionidae | *Anaedus* | darkling beetles |

*Continued*

APPENDIX 1. *Concluded.*

| PHYLUM | SUBPHYLUM | CLASS | SUBCLASS | ORDER | FAMILY | GENUS | COMMON NAME |
|---|---|---|---|---|---|---|---|
| Arthropoda | Uriramia | Insecta | Pterygota | Coleoptera | Tenebrionidae | *Blapstinus* | |
| | | | | | | *Edrotes* | |
| | | | | | | *Eleodes* | |
| | | | | | | *Melanastus* | |
| | Cheliceriformes | Chelicerata | Merostomata | Xiphosura | Limulidae | *Limulus* | horseshoe crab (eggs) |
| | | | Arachnida | Acari | Ixodidae | *Dermacentor* | mites and ticks |
| | | | | | Galumnidae | *Eporibatula* | beetle mites |
| | | | | | Macrochelidae | | mites |
| | | | | | Paraholaspidae | | mites |
| | | | | Araneae | Argiopidae | *Avanus* | orb web spiders |
| | | | | | | *Tetragnatha* | |
| | | | | | Attidae | | jumbing spiders |
| | | | | | Clubionidae | | |
| | | | | | Linyphiidae | *Erigone* | small spiders |
| | | | | | Lycosidae | *Tarentula* | wolf spiders |
| | | | | | Salticidae | | |
| | | | | Diploda | Julidae | | millipedes |
| | | | | | Polydesmidae | | |
| | | | | Chilopoda | Geophilidae | *Arenophilus* | centipedes |
| | | | | | Lithobiidae | | |
| Echinodermata | Eleutheroza | Echinoidea | | Echinoida | Echinometridae | *Echinometra* | urchins |
| | | Holothurioidea | | Apodida | Chiridotidae | *Chiridota* | |
| | | Ophiuroidea | | Ophiurida | | | brittle stars |
| Chordata | Vertebrata | Osteichthyes | | Cypriniformes | Cyprinidae | *Pimephales* | minnows |
| | | | | Perciformes | Gobiidae | *Clevelandia* | mud-burrowing goby, |
| | | | | Salmoniformes | Argentinidae | *Argentina* | herring smelts |
| | | | | Atheriniformes | Cyprinodontidae | *Fundulus* | killifishes |
| | | Amphibia | | Urodela | Plethodontidae | *Plethodon* | salamanders |
| | | | | Anura | Ranidae | *Rana* | frogs |
| | | Reptilia | | Squamata | Iguanidae | *Anolis* | chameleon |
| | | | | | Scincidae | *Eumeces* | skink |

# Population Estimate and Habitat Associations of the Loggerhead Shrike, *Lanius ludovicianus*, in Southeastern Alberta

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Bjorge, Ronald R., and David R. C. Prescott. 1996. Population estimate and habitat associations of the Loggerhead Shrike, *Lanius ludovicianus*, in southeastern Alberta. Canadian Field-Naturalist 110(3): 445–449.

We used 26 randomly-selected 41.5 $km^2$ blocks to census Loggerhead Shrike populations in core breeding areas of southeastern Alberta in 1993. We estimated the breeding population in the 23 600 $km^2$ study area (approximately one-third of the species' breeding range in Alberta) to be 2477 pairs (95% confidence interval of 1588 to 3365 pairs), which is higher than total population estimates made previously for the province as a whole. The number of breeding pairs in a block was highest where shrubs were prevalent, and shrikes were found more often than expected in areas with farmyards/shelterbelts and road allowances, and where a variety of land uses were present. Almost half of all shrikes were observed >200 m from a road, and would probably be undetectable by roadside surveys. Furthermore, only 63% of birds near roads were detected from a moving vehicle. We therefore suggest that only 32.9% of birds on the study area would be detected by a roadside survey.

Key Words: Loggerhead Shrike, *Lanius ludovicianus*, habitat selection, population size, censuses, Alberta.

Loggerhead Shrike (*Lanius ludovicianus*) populations are considered to be in jeopardy throughout much of their range. In the United States and Canada, populations have declined significantly since the 1960s (Cadman 1985; Morrison 1981; Robbins et al. 1986), although numbers have been relatively stable over the past decade (Price et al. 1995). The Loggerhead Shrike is classified as endangered in eastern Canada and threatened in western Canada (Johns et al. 1994). In the United States, the Loggerhead Shrike has been included in the Audubon Blue List for declining species (Tate 1986). Several states in the Great Lakes region have listed the species as being endangered (Hands et al. 1989).

The management of sensitive species requires measurements of populations size and trends. This is especially true when recovery plans tie management goals to specific population sizes (Johns et al. 1994). Population size and trends of the Loggerhead Shrike have been estimated by a variety of methods. These include Christmas Bird Counts (Morrison 1981), Breeding Bird Surveys (Robbins et al. 1986), roadside surveys (Telfer et. al. 1989; Robert and Laporte 1991; Smith and Kruse 1992), and complete counts in the case of small or localized populations (Cadman 1985; Wershler 1989*).

In Alberta, the range of the Loggerhead Shrike appears to have contracted substantially during recent decades (Telfer et al. 1989; Collister 1994), but the current population size of the species is unknown. Wershler (1989*) estimated a provincial population of 350 pairs based on complete counts of sites which were known to support shrikes, and extrapolations to other areas of known habitat. An assumption of that approach was that few shrikes were located elsewhere in the province, and that such populations were at very low densities. Extensive roadside surveys conducted by Telfer et al. (1989) indicated "fewer than 1000 pairs" in the province. However, information from the Alberta breeding bird atlas project (Semenchuk 1992), and casual observation by wildlife professionals, suggested that Loggerhead Shrikes may be more abundant.

Our primary objective was to estimate the population size of Loggerhead Shrikes in the core breeding areas of Alberta using a random sampling technique. This approach has been used to estimate widely-dispersed populations of other endangered or relatively rare species (Leighton et al. 1979; Schmutz 1984). Random sampling allows investigators to determine distribution over large areas and to estimate populations with a measure of precision. Secondary objectives were to describe habitat features of areas occupied by shrikes, and to assess the effectiveness of random block censuses versus roadside surveys that have previously been used to estimate populations of the Loggerhead Shrike in Alberta (Telfer et al. 1989).

## Study Area and Methods

The study area encompassed 23 600 $km^2$ in the mixed-grass ecoregion (Strong and Leggatt 1992) of east-central Alberta. Native grasslands in this area

*Unpublished, see Document Cited Section which follows Acknowledgments.

are dominated by Needle-and-Thread (*Stipa comata*), Blue Grama (*Bouteloua gracilis*), and Northern (*Agropyron dasystachyum*) and Western (*A. smithii*) wheatgrass. Willows (*Salix* spp.) and Trembling Aspen (*Populus tremuloides*) are the dominant woody vegetation, although Thorny Buffaloberry (*Sheperdia argentea*) is locally common as single trees or clumps where sufficient moisture is present. Overall, the region receives 156 mm (median) of summer precipitation, which usually accumulates during fewer than 10 days. Cattle grazing and cereal crop production are the dominant land uses. The study area enclosed about 35% of the current range of the Loggerhead Shrike in the province, and contained the majority of confirmed breeding records found during the bird atlas project (Semenchuk 1992).

Population estimates were derived from censuses conducted in 26, 6.4 x 6.4 km (41.5 km$^2$) blocks that enclosed about 4.7% of the total study area (Figure 1). Most blocks were originally selected by Schmutz (1984, 1989) for estimating populations of Ferruginous Hawks (*Buteo regalis*). We opted to reuse established study blocks for several reasons. First, we had no prior knowledge of shrike populations in these blocks or within the study area as a whole, and therefore had no reason to stratify our sampling effort based on local shrike densities. Second, the original selection criteria for these blocks was not biased towards particular habitat features that might influence shrike distribution and abundance. Finally, there would be a higher probability of sufficient time and money to repeat the study in future years if more than one species could be inventoried at a time. In areas where the study area extended beyond the hawk study boundary, new survey blocks were randomly selected. All study plots were mapped on a 1:500 000 Alberta base map to facilitate locating the block on the ground. A 1:50 000 NTS map was used for more detailed information while conducting the inventory.

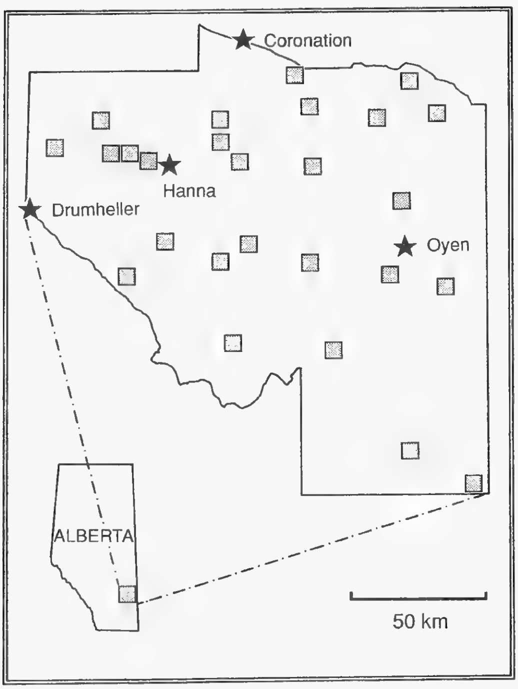


FIGURE 1. Study area and location of 41.5 km$^2$ blocks used to survey Loggerhead Shrike populations in south-eastern Alberta in 1993.

Following field trials of the census protocol in 1992, intensive sampling of the survey blocks occurred between 15 June and 7 July 1993. Observers usually worked independently, and spent between 2 and 30 (average 12) party hours in each block using a combination of truck, all-terrain vehicle and foot travel. To ensure that weather did not influence detectability of birds, we avoided periods with rain, temperatures >25°C, or winds >25 km/h. All areas containing woody vegetation within the block were surveyed. Due to time constraints, we focused on locating adults, and did not actively search for nests. When detected, the position of birds was recorded on standardized data sheets and 1:50 000 maps. Shrikes observed near the edge of blocks were included only if they were within the block when first encountered. Independent observations of shrikes within 400 m of another observation were considered to be either the same pair or the same individual, unless simultaneous observation of birds indicated otherwise. This distance would include the majority of the area utilized by a breeding pair of shrikes in this area (Collister 1994). Observation of a single shrike was regarded as an indicated pair. This was a reasonable assumption because repeat visits to nine territories (six in 1992, three in 1993) where single observations of shrikes were originally made, later revealed two adults and a nest with eggs or young in all cases. Furthermore, Collister (personal communication) concluded that occurrence of unpaired adult shrikes on his intensive study area in south-eastern Alberta was essentially non-existent. Population size in the study area was estimated by calculating the mean number of shrike pairs per block, and extrapolating this value, with 95% confidence limits, to the study area as a whole.

We determined habitat associations of Loggerhead Shrikes within the study area on two spatial scales. First, we determined the relative proportions of predominant land use in each of the census blocks by plotting different habitats on field data sheets of each block. Specific land uses considered were the number of farmyards/shelterbelts, and the percentage of annual cultivation, native pasture and tame grass (pasture or hayland). We used Spearman rank correlations (Conover 1980) to test for associations

between the relative abundance of each habitat type in a block with the number of indicated breeding pairs of shrikes in that block. We also counted the number of clusters of shrubs and trees in a block, and divided woody plant density into LOW (< 50 clusters), MEDIUM (50 to 100), and HIGH (> 100). A cluster ranged from a few trees or shrubs to many trees covering up to 2 ha. The effect of shrub density on the number of breeding pairs was analyzed using Kruskall-Wallis tests and simultaneous test procedures (Conover 1980). Second, we tabulated the frequency of occurrence of five different land uses (annual cultivation, native pasture, tame grass, road or railway rights-of-way, and farmyards/shelterbelts) within 400 m of points where shrikes were first encountered. This radius was chosen because it is the maximum distance that shrikes routinely travel from their nest sites while foraging (Collister 1994). We then randomly selected an equal number of 400-m radius circles from the study blocks using a random number generator. The frequency of occurrence of each habitat type, as recorded on field sheets, was then compared between observed and random sites using chi-square tests. We also determined the total number of these habitat types occurring in each 400 m circles, and compared values between observed and random circles using Mann-Whitney U-tests.

To determine the relative efficiency of roadside versus block surveys in censusing Loggerhead Shrikes, we classified the positions of shrike encounters in relation to the distance from the nearest road as follows: NEAR, 0-200 m; MEDIUM, 201-400 m; and FAR, > 400 m. Chi-square tests were used to test for differences in frequency of occurrence of shrikes across distance. For calculating expected values, we estimated that 17.8% of the study area occurred in the NEAR category, 17.6% occurred in the MEDIUM class, and 64.6% occurred > 400 m from roads.

## Results

Loggerhead Shrikes were encountered in 21 of 26 (80.8 %) study blocks during 1993. A total of 113 breeding pairs was observed during the census, for a mean density of 4.35 ± 0.75 (SE) pairs per 41.5 $km^2$ block (range 0 to 14). There were 569.3 blocks such in the 23 600 $km^2$ study area, for an overall population of 2477 pairs and a 95% confidence interval of 1588 to 3365 pairs.

Native pasture was the dominant land use in the study blocks (49.6 ± 6.3% of area), followed by annual cultivation (43.4 ± 6.6%) and tame grass (5.0 ± 6.3%). The number of farmyards/shelterbelts in a block ranged from 0 to 14 (mean = 6.08 ± 0.83). There were no correlations between the percent of any of the above major land uses with the number of breeding shrike pairs observed in a block (all $r_s < 0.23$, all $p > 0.27$). However, there was a relationship between the relative density of woody vegetation and the number of breeding pairs (T = 7.0, df = 2, $p < 0.04$), with significant differences in breeding pairs occurring between the LOW (2.33 ± 0.66 pairs, n = 12) and HIGH (6.6 ± 1.6 pairs, n = 7) shrub densities ($p < 0.05$). The number of shrike pairs observed in blocks with MEDIUM shrub density (5.6 ± 1.6 pairs, n = 7) was not significantly different from either the LOW or HIGH classes ($p > 0.05$).

TABLE 1. Comparison of major land-uses within a 400-m radius of Loggerhead Shrike observations ("occupied", n = 113), and in 113 randomly-selected circles within study blocks.

| Land Use | Frequency of Occurrence (%) | | |
|---|---|---|---|
| | Occupied | Random | $\chi^2$ |
| Tame Grass | 15.9 | 11.5 | 0.9 |
| Native Pasture | 61.9 | 63.7 | 0.1 |
| Cultivation | 71.7 | 60.2 | 3.3 |
| Rights-of-Way | 63.7 | 32.7 | 21.7* |
| Farmyards/Shelterbelts | 45.1 | 12.4 | 29.6* |

*P < 0.0001

Land-use characteristics of occupied and random 400-m plots are given in Table 1. The overall distribution of habitats in the two classes was different ($\chi^2 = 19.3$, df = 4, $p < 0.001$), with the frequency of occurrence of rights-of way and farmyards/shelterbelts being significantly higher in occupied sites (both $\chi^2 > 21.7$, df = 2, $p < 0.0001$). Shrikes also preferred sites that contained several habitat types within a 400-m radius. Occupied sites contained 2.6 ± 0.1 habitat types, whereas random sites contained only 1.8 ± 0.1 types (Mann-Whitney U-test, T = 6.2, $p < 0.0001$). Only 13 of 113 observed pairs (11.5%) occurred in areas that contained a single major habitat type, compared to 38.9 % of random locations.

The frequency of occurrence of shrikes was dependent on the distance from roads ($\chi^2 = 30.0$, df = 2, $p < 0.0001$), with the majority of pairs (52.2%) being detected within 200 m. An additional 6.2% were found between 200 and 400 m, whereas 41.6% were found > 400 m from roads, and unlikely to be routinely detected by roadside surveys.

## Discussion

Our major objective was to estimate the population size of Loggerhead Shrikes within the core breeding area of Alberta using a random sampling technique. Our results show that shrike populations are substantially higher than previously estimated (350-1000 pairs; Telfer et al. 1989; Wershler 1989*). In our study area alone, we estimate with 95% confidence that between 1588 and 3365 pairs of shrikes (mean of 2477 pairs) occurred during the study period. This might be a conservative estimate, because we assumed that birds observed within 400 m of each other were members of the same pair. However,

adjacent nests of Loggerhead Shrikes in Alberta have occasionally been observed less than 80 m apart (Collister 1994). We did not actively search for nests during our survey, so the frequency of nests closer than 400 m to each other, and the resulting impact on estimated pair densities in a survey block is unknown. Although the study area we sampled likely contains the highest densities of shrikes in Alberta, it encompassed only about 35% of the species' provincial breeding range. Thus, the true provincial population might reasonably be estimated to be double the size of the population that we calculated for our study area (i.e., close to 5000 pairs).

Previous population studies of the Loggerhead Shrike in Alberta may have under-estimated population sizes for several reasons. First, complete counts of known breeding areas (e.g., Wershler 1989*) cover a fairly small geographic range where shrikes are most likely to be encountered, and do not sample vast areas of the province where shrikes occur in relatively low densities. Roadside surveys (e.g., Telfer et al. 1989) cover extensive geographical areas, and tend not to be biased towards where shrikes are expected to occur. However, our study indicated that only 52.2% of shrikes located in randomly-selected blocks were found within detection distance of a road. Furthermore, birds in our study area were typically associated with shelterbelts and clumps of shrubs. Even though shrikes often perch conspicuously on vegetation, adequate censusing of these habitats was achieved only by walking around or through the potential nesting cover. Vehicle surveys conducted at 50-70 km/hr (Telfer et al. 1989), and on only one side of shrub or tree patches, would overlook many resident shrikes that we recorded via intensive ground searches. In fact, incidental observations conducted during previous roadside surveys on the prairies revealed many sample blocks where shrikes were overlooked by observers in vehicles (Telfer et al. 1989). We made no systematic effort to determine the percentage of birds known to occur near roads that were detected from a moving vehicle. However, of the 27 pairs of shrikes observed within 200 m of roads by the senior author, 17 (63%) were initially detected while driving. This value, coupled with the proportion of shrikes that were found near roads, suggests that only 32.9% of the population would be detected from an extensive roadside survey in our study area. Despite this, roadside surveys may be the most efficient means of surveying broad geographical areas, but only if appropriate corrections for detectibility are applied. Such correction factors likely vary among habitat types, and would need to be calculated for each geographical area being surveyed.

Loggerhead Shrikes are heterogeneously distributed over the study area, with the number of indicated breeding pairs in a 41.5 $km^2$ block ranging from 0 to 14. Pair numbers were highest in blocks with relatively high concentrations of native trees and shrubs, and in areas where farmyards/shelterbelts and rights-of-way were more common than expected by chance. The association with woody vegetation is not surprising, given the nesting requirements of shrikes, and the relative scarcity of trees and shrubs in many parts of the species' range in Alberta. Accordingly, we concur with Telfer (1992) who recommended planting appropriate shrubs for nesting and perching as a means of increasing local shrike populations. Our data indicate that shrubs would best be planted in areas with considerable vegetation diversity, such as on the interface of tame and native pastures. Road allowances, which typically separate different land uses, and provide power lines and fences for perching (Bohall-Wood 1987) and tall grasses for foraging (Prescott and Collister 1993; Chavez-Ramirez et al. 1994) would also be suitable for shrub and tree plantings. Given the tendency of shrikes to inhabit farmyards, we also suggest that programs designed to preserve existing tree growth in abandoned farmyards be an important component of management plans for Loggerhead Shrikes on the Canadian prairies.

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# Four Records of the Chestnut Lamprey, *Ichthyomyzon castaneus*, New to Ontario


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We report on the widespread, although rare, presence of the parasitic Chestnut Lamprey (*Ichthyomyzon castaneus*) in Ontario based on four collections and five specimens. This report increases the number of lamprey species for the province to five, three of which are parasitic. The Chestnut Lamprey is sympatric with three of the four other Ontario lamprey species.



Key Words: Chestnut Lamprey, *Ichthyomyzon castaneus*, Ontario, Petromyzontidae.


We report on the widespread although rare occurrence of the parasitic Chestnut lamprey, *Ichthyomyzon castaneus* Girard, 1858, in Ontario (Figures 1 and 2). During the course of routine curatorial work, three collections of lampreys in The Canadian Museum of Nature (CMN) were found to contain four transformed specimens of this species. A fourth collection of a single immature transformed specimen (149.0 mm TL) was made on the 3 August 1994 in the St. Lawrence River off the northeast side of eastern Colquhoun Island (45°01'N 74°38'W) near Cornwall, Glengarry County, and has since been deposited in the Canadian Museum of Nature (CMN) [formerly National Museum of Canada, NMC] (alphanumeric catalogue code NMC95-7). The specimen was collected in a trapnet by one of us (SCR) in swift, very clear water over a rocky and weedy substrate.

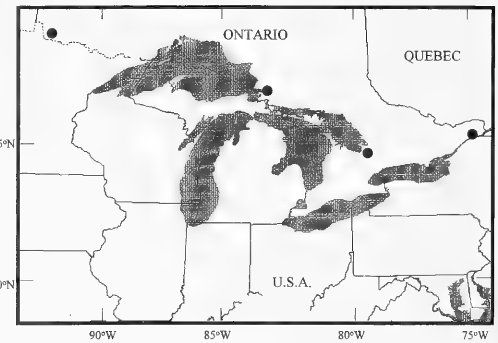


FIGURE 1. Geographic distribution of *Ichthyomyzon castaneus* in Ontario.

The first collection (NMC 86-856) was made on the 18 May (year unrecorded) in the Mad River (44°24'N 79°54'W), Simcoe County, Georgian Bay watershed, Lake Huron basin. One transformed male Chestnut Lamprey in spawning condition (224.5 mm TL), two transformed Northern Brook Lampreys (*Ichthyomyzon fossor*), three transformed Silver Lampreys (*I. unicuspis*) and 15 transformed Sea Lampreys (*Petromyzon marinus*) were collected in a

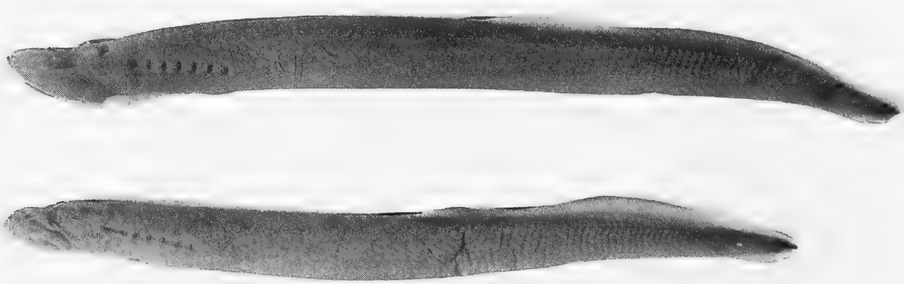

FIGURE 2. Side-view of two transformed *Ichthyomyzon castaneus* from Lake of the Woods, Ontario (NMC70-223). The specimen above measures 164.5 mm in total length and the one below 144.0.

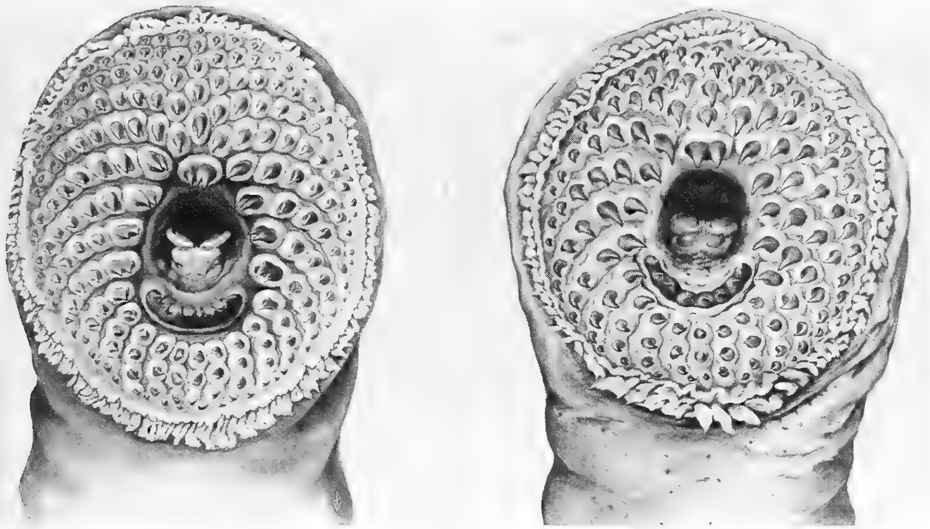

FIGURE 3. Drawings of the oral disc in the two species of *Ichthyomyzon*. Left side: *I. castaneus*, Sac River, Missouri, 20-23 May 1951 (closed disc measures 15.0 mm). Note the seven bicuspid endolaterals; Right side: *I. unicuspis*, Manitoba, no other collection data (closed disc measures 20.0 mm). Note the absence of bicuspid endolaterals. Modified from Vladykov and Kott (1980) with permission from the Canadian Journal of Fisheries and Aquatic Sciences.

large trap by M. Milson. The Mad River, therefore, harbours three parasitic lamprey species.

The second collection (NMC 83-918) was made on the 6 July 1966 in the Chippewa River (46°58'N 84°21'W), Algoma District, Batchawana Bay watershed, Lake Superior basin. One spent transformed female Chestnut Lamprey (207.5 mm TL) and one transformed Sea Lamprey were collected by electrofishing by members of the Sea Lamprey Control Centre in Sault-Ste-Marie.

The third collection (NMC 70-223) was made in the summer of 1970 in Lake of the Woods, southwest of Burton Island (48°59'N 94°27'W), Rainy River District. Two immature transformed Chestnut Lampreys (144.0-164.5 mm TL) and 64 transformed Silver Lampreys were collected by Pat O'Connor, a commercial fisherman. The specimens were collected in still, clear, and brown-tinged water over a stony substrate, at a maximum depth of 20 m.

Specimens of *Ichthyomyzon* were identified to species using Lanteigne (1981). Teeth nomenclature follows Vladykov and Follett (1967). According to Lanteigne (1981), the Chestnut Lamprey is distinguished from the Silver Lamprey (Figure 3), another parasitic species with which it could be confused by the presence of 2-8 (usually 4-8) bicuspid endolaterals ($n = 36$; $\bar{X} = 5.9$) as opposed to 0-2 (usually 0) bicuspid endolaterals ($n = 43$; $\bar{X} = 0.06$). Four of the five transformed specimens in this study possessed either four or five bicuspid endolaterals. The fifth transformed specimen (NMC 83-918) possessed at least three bicuspid endolaterals; the condition of one of its endolaterals could not be ascertained because it was missing. On the other hand, the 67 transformed specimens of the Silver Lamprey in this study possessed only 0-2 bicuspid endolaterals

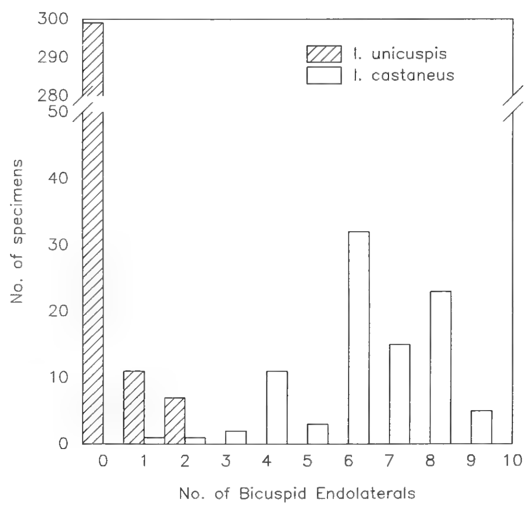


FIGURE 4. Histogram of frequencies of the number of bicuspid endolaterals in *Ichthyomyzon unicuspis* and *I. castaneus* based on the data contained in Table 1 minus the two specimens for which the condition in one tooth could not be ascertained.

TABLE 1. Comparison of various dentitional counts in *Ichthyomyzon unicuspis* versus *I. castaneus*.

| Species | Number of Bicuspid Endolaterals | | | | | | | | | | | | Number of Anterior Rows | | | | | Number of Lateral Rows | | | | | | | | Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | x̄ | 2 | 3 | 4 | 5 | x̄ | 5 | 6 | 7 | 8 | 9 | 10 | 11 | x̄ | |
| *I. unicuspis* | 245 | 5 | 1 | - | - | - | - | - | - | - | - | 0.03 | 9 | 165 | 45 | - | 3.16 | 8 | 219 | 234 | 40 | - | - | - | 6.61 | Hubbs and Trautman (1937) |
| | 54 | 6 | 7* | - | - | - | - | - | - | - | - | 0.30 | 2 | 54 | 11 | - | 3.13 | 3 | 59 | 63 | 9 | - | - | - | 6.58 | Present Study |
| *I. castaneus* | - | 1 | 1 | 2 | 9 | 1 | 32 | 15 | 23 | 5 | 2 | 6.55 | - | 2 | 20 | 34 | 4.57 | - | 1 | 23 | 58 | 75 | 19 | 3 | 8.54 | Hubbs and Trautman (1937) |
| | - | - | - | 1* | 2 | 2 | - | - | - | - | - | 4.20 | - | 4 | 1 | - | 3.20 | 2 | 5 | 3 | - | - | - | - | 6.10 | Present Study |

*One endolateral tooth missing for which the number of cusps could not be ascertained.

(Table 1). A histogram combining the data in Hubbs and Trautman (1937) and this study with regards to the number of bicuspid endolaterals clearly shows that *I. unicuspis* has a strong mode at 0 and *I. castaneus* a strong mode at 6 (Figure 4). Examination of the number of anterior and lateral rows, two characters suggested by Hubbs and Trautman (1937) of lesser diagnostic value, were not found useful in this study (Table 1). These latter two counts included the marginal teeth as in Hubbs and Trautman (1937).

In Canada, the Chestnut Lamprey has been reported previously only from Saskatchewan and Manitoba (Lanteigne 1992). It is not listed in Mandrak and Crossman (1992a), and is not even included in their list of potential fish invaders of Ontario.

The distribution of the Chestnut Lamprey in Ontario matches a pattern that Mandrak and Crossman (1992b) broadly term "distribution limited to the Great Lakes and Nelson River watersheds". Its present-day distribution (Lanteigne 1992) leads us to suggest that its presence in Lake of the Woods is the result of a post-Wisconsinan reinvasion from the Missourian and/or Mississippian Refugium while its presence in the Chippewa, Mad and St. Lawrence rivers is the result of a reinvasion of the species from the Mississippian Refugium. Lanteigne (1992) reports that the Chestnut Lamprey presently occurs in both the Upper and Lower Missouri as well as the Upper and Lower Mississippi River basins.

According to Lanteigne (1981), the Chestnut Lamprey and the Silver Lamprey occur sympatrically in the Hudson Bay, Upper Mississippi River and Ohio River basins. The basins of lakes Superior and Huron and of the St. Lawrence River can now be added to this list.

Ontario material of transformed individuals of *I. unicuspis* held at the Canadian Museum of Nature consist of 36 collections totalling 153 specimens. Ontario material at the Royal Ontario Museum amounts to 48 collections and 84 specimens (Erling Holm, personal communication). On this basis, the number of Ontario specimens of *I. castaneus* reported here represents only 2.10% of the Ontario specimens of *I. unicuspis* and is an indication of the former's relative rarity. The Committee on the Status of Endangered Wildlife in Canada designated the species *I. castaneus* as vulnerable in 1991 (Lanteigne 1992), and this designation is still appropriate, despite its broader distribution recorded here, because of its apparent rarity.

## Acknowledgments

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Lee Willard, Martin D. Lemay and David Bajurny participated in the fieldwork. We thank Sylvie Laframboise, CMN, for bringing an odd Chippewa River lamprey to our attention; André Dumouchel for producing Figure 2; the Audiovisual and Reprography Services of UO for the layout of Figure 3; and Alison Murray, CMN, for producing Figure 4. We also thank Erling Holm for permission to use information on material from the Royal Ontario Museum and the four reviewers for forcing us to take a second look at our data.

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# Rare and Endangered Fishes and Marine Mammals of Canada: COSEWIC Fish and Marine Mammal Subcommittee Status Reports: X

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Campbell, Robert R. *Editor*. 1996. Rare and endangered fish and marine mammals of Canada: COSEWIC Fish and Marine Mammal Subcommittee Status Reports: X. Canadian Field-Naturalist 110(3): 454–461.

Nine status reports representing the 1994 fish and marine mammal status assignments by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) have been prepared for publication and two species previously assigned status reviewed. Committee (COSEWIC) and Subcommittee (Fish and Marine Mammals) activities are briefly discussed as are the implications of a British Columbia Court of Appeal ruling rending habitat sections of the Fisheries Act inoperable for non-commercial or non-game species. Tabular lists of fishes and marine mammal species assigned status to April 1994 and species currently under consideration are presented and new category definitions are outlined.

Neuf rapports de statut relativement aux poissons et aux mammifères marins auxquel ont été attribué un statut en 1994 ont été préparés pour publication et on a mis à jour les rapports de deux espèces qui possédaient un statut. Les activités du Comité (CSEMDC) et du souscomité (des poissons et des mammifères marins) sont brièvement discutées, de même que les implications d'une décision prise par la cour d'appel de la C.-B., qui rend inopérantes les sections de l'habitat de la Loi sur La Pêche pour les espèces non-commerciales ou non-sportives. Des listes sous forme tabulaire des espèces de poisson et de mammifères marins qui ont reçu un statut en date d'avril 1994, des espèces toujours à l'étude et les nouvelles définitions de catégorie sont présentées.

Key Words: Rare and Endangered species, fish, marine mammals, COSEWIC.

Previous submissions (Campbell 1984 through 1993), have stated and repeated the intent of the Subcommittee on Fish and Marine Mammals to publish the status reports (on those species of fish and marine mammals) which the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) has reviewed, approved and used as a basis of assigning status to species in jeopardy in Canada. The nine reports presented in this issue are the fish and marine mammal component of those species assigned status in 1994 (see Table 1).

## Progress

COSEWIC has undertaken to make available to all Canadians supporting information on each species classified (see Cook and Muir 1984). The Fish and Marine Mammal Subcommittee used *The Canadian Field-Naturalist* as one step in achieving the goal. A series of reports have appeared from 1984 through 1993 [see *The Canadian Field-Naturalist* 98(1): 63-133; 99(3): 404-450; 101(2): 165-309; 102(1): 81-176 and 102(2): 270-398; 103(2): 147-220; 104(1): 1-145; 105(2): 151-250; 106(1): 1-72; 107(4): 395-546].

Commencing in April 1994 the Canadian Wildlife Federation agreed to support COSEWIC report preparation through a system of matching grants and some $40 000 ($10 000 contributed by the Canadian Wildlife Service) was available to support the various subcommittees in 1993 through 1994.

As of April 1994, COSEWIC has reviewed the status of 85 fish species, one marine invertebrate, and 38 marine mammals (Table 1). Of the 124 species considered six were found to be indeterminate (five fish, one marine mammal), 52 (21 fish, 30 marine mammals, one marine invertebrate) were found not to require status designation and another 43 (38 fish, five marine mammals) were designated as vulnerable, mainly due to natural rarity, leaving 23 species of immediate concern which are of interest to the RENEW (Recovery of Nationally Endangered Wildlife) organization which was established in 1990 to oversee the development of recovery teams and plans for such species listed by COSEWIC (CWS 1993).

There are currently 26 status reports on fish and 10 on marine mammal species under review or in preparation (Table 2).* As well, some 54 additional species of fish, two of marine mammals and 12 marine invertebrates have been identified as being worthy of consideration (see Campbell 1993: Table 3). Many may be found to not require status designation, but the process serves to bring together the information necessary to make a formal determina-

**Editor's note:* Some of these were subsequently presented at the 1996 Annual Meeting of COSEWIC.

TABLE 1. Fish and Marine Mammal Species with Assigned COSEWIC Status to 14 April 1994.

| Species | Scientific Name | Status | Date Assigned |
|---|---|---|---|
| **Fish** | | | |
| Lake Sturgeon | *Acipenser fulvescens* | RANSDR[a] | April 1986 |
| Bloater | *Coregonus hoyi* | RANSDR | April 1988 |
| Blueback Herring | *Alosa aestivalis* | RANSDR | April 1980 |
| Striped Shiner | *Luxilus chrysocephalus* | RANSDR | April 1993 |
| Redfin Shiner | *Lythrurus umbratilis* | RANSDR | April 1988 |
| Hornyhead Chub | *Nocomis biguttatus* | RANSDR | April 1988 |
| River Chub | *Nocomis micropogon* | RANSDR | April 1988 |
| Ghost Shiner | *Notropis buchanani* | RANSDR | April 1993 |
| Blackchin Shiner | *Notropis heterodon* | RANSDR | April 1994 |
| Cutlips Minnow | *Exoglossum maxillingua* | RANSDR | April 1994 |
| Leopard Dace | *Rhinichthys falcatus* | RANSDR | April 1990 |
| Mountain Sucker | *Catostomus platyrhynchus* | RANSDR | April 1991 |
| Golden Redhorse | *Moxostoma erythrurum* | RANSDR | April 1989 |
| Least Darter | *Etheostoma microperca* | RANSDR | April 1989 |
| Tesselated Darter | *Etheostoma olmstedi* | RANSDR | April 1993 |
| River Darter | *Percina shumardi* | RANSDR | April 1989 |
| Green Sunfish | *Lepomis cyanellus* | RANSDR | April 1987 |
| Longear Sunfish | *Lepomis megalotis* | RANSDR | April 1987 |
| Spoonhead Sculpin | *Cottus ricei* | RANSDR | April 1989 |
| Brook Silverside | *Labidesthes sicculus* | RANSDR | April 1989 |
| Y-Prickleback | *Allolumpenus hypochromus* | RANSDR | April 1991 |
| Darktail Lamprey | *Lethenteron alaskense* | RAISIFSD[b] | April 1990 |
| Bering Cisco | *Coregonus laurettae* | RAISIFSD | April 1990 |
| Flathead Catfish | *Pylodictis olivaris* | RAISIFSD | April 1993 |
| Northern Madtom | *Noturus stigmosus* | RAISIFSD | April 1993 |
| Pixie Poacher | *Occella impi* | RAISIFSD | April 1991 |
| Lake Lamprey[c] | *Lampetra macrostoma* | Vulnerable[d] | April 1986 |
| Chestnut Lamprey | *Ichthyomyzon castaneus* | Vulnerable | April 1991 |
| Northern Brook Lamprey | *Ichthyomyzon fossor* | Vulnerable | April 1991 |
| Shortnose Sturgeon | *Acipenser brevirostrum* | Vulnerable | April 1980 |
| Green Sturgeon | *Acipenser medirostris* | Vulnerable | April 1987 |
| White Sturgeon | *Acipenser transmontanus* | Vulnerable | April 1990 |
| Spotted Gar | *Lepisosteus oculatus* | Vulnerable | April 1983[m] |
| Spring Cisco[c] | *Coregonus* sp. | Vulnerable | April 1992 |
| Squanga Whitefish[c] | *Coregonus* sp. | Vulnerable | April 1988 |
| Kiyi | *Coregonus kiyi* | Vulnerable | April 1987 |
| Pacific Sardine | *Sardinops sagax* | Vulnerable | April 1987 |
| Redside Dace | *Clinostomus elongatus* | Vulnerable | April 1987 |
| Silver Chub | *Macrhybopsis storeriana* | Vulnerable | April 1985 |
| Pugnose Shiner | *Notropis anogenus* | Vulnerable | April 1985 |
| Bigmouth Shiner | *Notropis dorsalis* | Vulnerable | April 1985 |
| Silver Shiner | *Notropis photogenis* | Vulnerable | April 1983[e] |
| Rosyface Shiner | *Notropis rubellus* | Vulnerable | April 1994 |
| Pugnose Minnow | *Opsopoeodus emiliae* | Vulnerable | April 1985 |
| Speckled Dace | *Rhinichthys osculus* | Vulnerable | April 1980[f] |
| Umatilla Dace | *Rhinichthys umatilla* | Vulnerable | April 1988 |
| Central Stoneroller | *Campostoma anomalum* | Vulnerable | April 1985 |
| Banded Killifish – Newfoundland | *Fundulus diaphanus* | Vulnerable | April 1989 |
| Blackstripe Topminnow | *Fundulus notatus* | Vulnerable | April 1985 |
| Lake Chubsucker | *Erimyzon sucetta* | Vulnerable | April 1994 |
| Bigmouth Buffalo | *Ictiobus cyprinellus* | Vulnerable | April 1989 |
| Black Buffalo | *Ictiobus niger* | Vulnerable | April 1989 |
| Spotted Sucker | *Minytrema melanops* | Vulnerable | April 1983[m] |
| River Redhorse | *Moxostoma carinatum* | Vulnerable | April 1983[e] |
| Greenside Darter | *Etheostoma blennioides* | Vulnerable | April 1990 |
| Brindled Madtom | *Notorus miurus* | Vulnerable | April 1985 |
| Redbreast Sunfish | *Lepomis auritus* | Vulnerable | April 1989 |
| Orangespotted Sunfish | *Lepomis humilis* | Vulnerable | April 1989 |
| Warmouth | *Lepomis gulosus* | Vulnerable | April 1994 |
| Fourhorn Sculpin – Arctic Islands | *Myoxocephalus quadricornis* | Vulnerable | April 1989 |

*(Continued)*

TABLE 1. *Continued.*

| Species | Scientific Name | Status | Date Assigned |
|---|---|---|---|
| Giant Stickleback[c] | *Gasterosteus* sp. | Vulnerable | April 1980 |
| Unarmoured Stickleback[c] | *Gasterosteus* sp. | Vulnerable | April 1983 |
| Blackline Prickleback | *Acantholumpenus mackayi* | Vulnerable | April 1989 |
| Bering Wolffish | *Anarhichas orientalis* | Vulnerable | April 1989 |
| Lake Simcoe Whitefish[c] | *Coregonus clupeaformis* ssp. | Threatened | April 1987 |
| Blackfin Cisco | *Coregonus nigripinnis* | Threatened | April 1988 |
| Shortnose Cisco | *Coregonus reighardi* | Threatened | April 1987 |
| Shortjaw Cisco | *Coregonus zenithicus* | Threatened | April 1987 |
| Black Redhorse | *Moxostoma duquesnei* | Threatened | April 1988 |
| Copper Redhorse[c] | *Moxostoma hubbsi* | Threatened | April 1987 |
| Eastern Sand Darter | *Ammocrypta pellucida* | Threatened | April 1994 |
| Channel Darter | *Percina copelandi* | Threatened | April 1993 |
| Margined Madtom | *Noturus insignis* | Threatened | April 1989 |
| Enos Lake Stickleback[c] | *Gasterosteus* sp. | Threatened | April 1988 |
| Shorthead Sculpin | *Cottus confusus* | Threatened | November 1983 |
| Deepwater Sculpin – Great Lakes | *Myoxocephalus thompsoni* | Threatened | April 1987 |
| Acadian Whitefish[c] | *Coregonus huntsmani* | Endangered | April 1983 |
| Aurora Trout[c] | *Salvelinus fontinalis timagamiensis* | Endangered | April 1987 |
| Salish Sucker | *Catostomus* sp. | Endangered | April 1986 |
| Paddlefish | *Polyodon spathula* | Extirpated | April 1987 |
| Gravel Chub | *Erimystax x-punctata* | Extirpated | April 1987[g] |
| Longjaw Cisco | *Coregonus alpenae* | Extinct | April 1988 |
| Deepwater Cisco | *Coregonus johannae* | Extinct | April 1988 |
| Banff Longnose Dace[c] | *Rhinichthys cataractae smithi* | Extinct | April 1987 |
| Blue Walleye | *Stizostedion vitreum glaucum* | Extinct | April 1985 |
| **Marine Molluscs** | | | |
| Northern Abalone | *Haliotis kamtschatkana* | N/A[h] | April 1988 |
| **Marine Mammals** | | | |
| Sea Otter | *Enhydra lutris* | Endangered | May 1978[i] |
| Sea Mink | *Mustela macrodon* | Extinct | April 1985 |
| Hooded Seal | *Cystophora cristata* | RANSDR | April 1986 |
| Bearded Seal | *Erignathus barbatus* | RANSDR | April 1994 |
| Steller Sea Lion | *Eumetopias jubatus* | RANSDR | April 1987 |
| Northern Elephant Seal | *Mirounga angustirostris* | RANSDR | April 1986 |
| Ringed Seal | *Phoca hispida* | RANSDR | April 1989 |
| California Sea Lion | *Zalophus californianus* | RANSDR | April 1987 |
| Atlantic Walrus | *Odobenus rosmarus rosmarus* | | |
| Eastern Arctic | | RANSDR | April 1987 |
| Northwest Atlantic | | Extirpated | April 1987 |
| Baird's Beaked Whale | *Berardius bairdi* | RANSDR | April 1992 |
| Beluga | *Delphinapterus leucas* | | |
| Beaufort Sea | | RANSDR | April 1986 |
| Western and Southern Hudson Bay | | RANSDR | April 1993 |
| High Arctic | | Vulnerable | April 1992 |
| Eastern Hudson Bay | | Threatened | April 1988 |
| St. Lawrence River | | Endangered | April 1983 |
| S.E. Baffin Island | | Endangered | April 1990 |
| Ungava Bay | | Endangered | April 1988 |
| Common Dolphin | *Delphinus delphis* | RANSDR | April 1991 |
| Grey Whale | *Eschrichtius robustus* | | |
| Northeast Pacific | | RANSDR | April 1987 |
| Northwest Atlantic | | Extirpated | April 1987 |
| Risso's Dolphin | *Grampus griseus* | RANSDR | April 1990 |
| Short-finned Pilot Whale | *Globicephala macrohynchus* | RANSDR | April 1993 |
| Longfinned Pilot Whale | *Globicephela malaena* | RANSDR | April 1994 |
| Northern Bottlenose Whale | *Hyperoodon ampullatus* | RANSDR | April 1993 |
| Pygmy Sperm Whale | *Kogia breviceps* | RANSDR | April 1994 |
| Atlantic White-sided Dolphin | *Lagenorhynchus acutus* | RANSDR | April 1991 |
| Pacific White-sided Dolphin | *Lagenorhynchus obliquidens* | RANSDR | April 1990 |

*(Continued)*

TABLE 1. *Concluded.*

| Species | Scientific Name | Status | Date Assigned |
|---|---|---|---|
| Northern Right Whale Dolphin | *Lissodelphis borealis* | RANSDR | April 1990 |
| Hubbs' Beaked Whale | *Mesoplodon carlhubbsi* | RANSDR | April 1989 |
| Blainville's Beaked Whale | *Mesoplodon densirostris* | RANSDR | April 1989 |
| True's Beaked Whale | *Mesoplodon mirus* | RANSDR | April 1989 |
| Stejneger's Beaked Whale | *Mesoplodon stejnegeri* | RANSDR | April 1989 |
| Narwhal | *Monodon monoceros* | RANSDR | April 1986[e] |
| Dall's Porpoise | *Phocoenoides dalli* | RANSDR | April 1989 |
| False Killer Whale | *Pseudorca crassidens* | RANSDR | April 1990 |
| Striped Dolphin | *Stenella coeruleoalba* | RANSDR | April 1993 |
| Bottlenose Dolphin | *Tursiops truncatus* | RANSDR | April 1993 |
| Cuvier's Beaked Whale | *Ziphius cavirostris* | RANSDR | April 1990 |
| Blue Whale | *Balaenoptera musculus* | Vulnerable | April 1983[f] |
| Fin Whale | *Balaenoptera physalus* | Vulnerable | April 1987 |
| Sowerby's Beaked Whale | *Mesoplodon bidens* | Vulnerable | April 1989 |
| Harbour Porpoise | *Phocoena phonoeca* | | |
| Northwest Pacific | | RAISIFSD | April 1991 |
| Northwest Atlantic | | Threatened | April 1990 |
| Humpback Whale | *Megaptera novaeangliae* | | |
| Northwest Atlantic | | Vulnerable | April 1985 |
| Northeast Pacific | | Threatened | April 1982[j] |
| Bowhead Whale | *Balaena mysticetus* | Endangered | April 1980[i] |
| Right Whale | *Eubalaena glacialis* | Endangered | April 1980[k] |

[a] RANSDR – Use of NIAC (Not in Any Category) dropped in 1988 and subsequently converted. RANSDR is not a category = Report Accepted No Status Designation Required.
[b] RAISIFSD – the use of a new list "Report Accepted Insufficient Scientific Information For Status Designation" was approved at the 1990 General Meeting.
[c] Endemic to Canada
[d] Vulnerable "Rare" category changed to "Vulnerable" in 1988. Dates Assigned of 1988 or earlier indicate date of original Rare status assignment. These were subsequently converted to Vulnerable at the 1990 General Meeting based on the advice of the Fish and Marine Mammal Subcommittee.
[e] Updated April 1987 – no status change.
[f] Updated April 1984 – no status change.
[g] Updated April 1987 – previous status of "Endangered" assigned April 1985.
[h] N/A –Status Not Assigned. COSEWIC has no mandate for invertebrates. Report accepted and recommended RANSDR Status agreed to, but not assigned.
[i] Updated April 1986 – no status change.
[j] Updated April 1985 – North Atlantic stock downlisted to "Vulnerable".
[k] Updated April 1985 and April 1990 – no status change.
[m] Updated April 1994 – no status change.

tion that they are not presently at risk. The Subcommittee will, as opportunity allows, attempt to document the status of all of these species and assign designations.

In addition to soliciting further status reports on species of concern, the Subcommittee continues to obtain updates on the status of selected species as new information becomes available, or in the 10-year review process initiated in 1993 (see Campbell 1993: Table 3) for those species not updated since their initial status assignment.

In that regard, updated reports on the Spotted Gar and Spotted Sucker were considered at the April 1994 General Meeting and the original (Table 1) vulnerable status reconfirmed for each. These reports are not included in the following series as the only differences from the original reports (Spotted Gar —Parker et al. 1980; Parker and McKee 1984a: Spotted Sucker — Parker et al. 1980; Parker and McKee 1984b) were the inclusion of new records. The only Spotted Gar record since 1975 that could be considered *bona fide* is the 1986 collection of two specimens from Rondeau Bay (ROM 51555) [Campbell 1994a]. The only new information on the Spotted Sucker in Canada since that reported by Parker et al. (1980) and Parker and McKee (1984b) are the 10 additional specimens obtained (see Campbell 1994b: Table 1) from Lake Erie and Lake St. Clair tributaries.

## Protection

An important 1983 court ruling which impacts on endangered fishes in Canada and COSEWIC reports has been previously overlooked. In the past the

TABLE 2. Fish and Marine Mammal Species for which Status Reports are in preparation, or under review – to 14 April 1994.

| Species | Scientific Name | Proposed Status |
|---|---|---|
| **Fish** | | |
| Atlantic Sturgeon | *Acipenser oxyrhynchus* | ? |
| Lake Sturgeon[2] | *Acipenser fulvescens* | ? |
| Red (Arctic) Char | *Salvelinus alpinus* ssp. | ? |
| Bull Trout | *Salvelinus confluentus* | Vulnerable |
| Mira Whitefish[1] | *Coregonus* sp. | Vulnerable |
| Opeongo Whitefish[1] | *Coregonus* sp. | Threatened |
| Lake Cisco | *Coregonus artedi* | Endangered |
| Lake Whitefish | *Coregonus clupeaformis* | Threatened – Lakes Erie and Ontario |
| Pygmy Whitefish | *Prosopium coulteri* | ? |
| Round Whitefish | *Prosopium cylindraceum* | Vulnerable |
| Pygmy Smelt | *Osmerus spectrum* | Vulnerable |
| Redfin Pickerel | *Esox americanus americanus* | Vulnerable – Quebec |
| Grass Pickerel | *Esox americanus vermiculatus* | Vulnerable |
| Chain Pickerel | *Esox niger* | Vulnerable ? |
| Chiselmouth | *Acrocheilus alutaceus* | Vulnerable - British Columbia |
| Western Silvery Minnow | *Hybognathus argyritis* | ? |
| Eastern Silvery Minnow | *Hybognathus nuchalis regius* | Vulnerable |
| Weed Shiner | *Notropis texanus* | Vulnerable |
| Bluntnose Minnow | *Pimphales notatus* | Vulnerable |
| Jasper Longnose Sucker[1] | *Castostomus castostomus lacustris* | Vulnerable |
| Spinynose Sculpin | *Asemichthys taylori* | Vulnerable – British Columbia |
| Cultus Pygmy Coastrange Sculpin[1] | *Cottus aleuticus* | Threatened – British Columbia |
| Mottled Sculpin | *Cottus bairdi* | Vulnerable – British Columbia, Alberta |
| Shorthead Sculpin[2] | *Cottus confusus* | Vulnerable |
| Texada Stickleback[1] | *Gasterosteus* sp. | Vulnerable |
| Bluefin Tuna | *Thunnus thynnus* | ? |
| **Marine Mammals** | | |
| Minke Whale | *Balaenoptera acutorostrata* | ? |
| Sei Whale | *Balaenoptera borealis* | ? |
| Bowhead Whale[2] | *Balaena mysticetus* | Endangered |
| Blue Whale[2] | *Balaenoptera musculus* | Vulnerable |
| Dwarf Sperm Whale | *Kogia simus* | Vulnerable |
| Whitebeaked Dolphin | *Lagenorhynchus albirostris* | ? |
| Killer Whale | *Orcinus orca* | ? |
| Sperm Whale | *Physeter catadon* | ? |
| Northern Fur Seal | *Callorhinus ursinus* | ? |
| Harp Seal | *Phoca groenlandica* | ? |

[1]Endemic to Canada
[2]Updated Status Report

"Protection" sections of these reports usually contained a general phrase to the effect that no specific legislation was in place for the protection of fish species, but that general protection, if required, was available under habitat sections of The Fisheries Act of 1867 (this would also apply for marine mammals, but specific Marine Mammal Regulations are also promulgated under the Act). However, in 1994, it was brought to our attention that in 1983 the British Columbia Court of Appeal, in a decision to become known as the "Tsitika Judgement", (resulting from a case between Regina and MacMillan Bloedel involving degradation and destruction of fish habitat in a section of the Tsitika River in British Columbia) ruled that the Fish Habitat Sections 31 and 33 of the Fisheries Act do not apply to those habitats that support fish which have no commercial value or sport value. In other words, there is no general vehicle to provide protection for minnows, forage species etc., only game fish and commercial species (J. Ptolemy, Fisheries Branch, British Columbia Ministry of Environment Lands and Parks, Victoria, B.C.; personal communication).

The Supreme Court of Canada refused the Federal Government appeal of the decision and apparently the Department of Fisheries and Oceans has no intent to address the situation through amendments to the Act or by Regulation under the Act (D. Good, Department of Fisheries and Oceans, Ottawa, Ontario; personal communica-

TABLE 3. COSEWIC definitions of conservation status.

| Category (Abbreviation) | Definition | |
|---|---|---|
| | 1988[2] – 1994 | New |
| Species | any species, subspecies or geographically separate population | any indigenous species, subspecies, variety or geographically defined population of wild fauna and flora |
| Report Accepted: Insufficient Scientific Information For Status Designation (RAISIFSD) | not a category, its use as a list was first approved in 1990 | |
| Inderminate (I) | | a species for which there is insufficient scientific information to support status designation |
| Report Accepted: No Status Designation Required (RANSDR) | not a category, its use as a list was first approved in 1988 to replace NIAC[1] | |
| Not At Risk (NAR) | | a species that has been evaluated and found to be not at risk |
| Vulnerable | any indigenous species of fauna or flora that is particularly at risk because of low or declining numbers, occurrence at the fringe of its range or in restricted areas, or for some other reason, but is not a threatened species | a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events |
| Threatened (T) | any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting its vulnerability do not become reversed | a species that is likely to become endangered if limiting factors are not reversed |
| Endangered (E) | any indigenous species of fauna or flora that is threatened with imminent extirpation or extinction throughout all, or a significant portion, of its Canadian range, owing to human action | A species facing imminent extirpation or extinction |
| Extirpated (XT) | any indigenous species of fauna or flora no longer existing in the wild in Canada but occurring elsewhere | a species no longer existing in the wild in Canada, but occurring elsewhere |
| Extinct (X) | any species of fauna or flora formerly indigenous to Canada, but no longer existing anywhere | a species that no longer exists |

[1]For definitions prior to 1988 see Cook and Muir (1984).
[2]NIAC = not in any category, used as list until 1988.

tion). It has been left to provincial jurisdictions to deal with this through their legislative processes. To date we are not aware of any action taken by the provinces and any such attempt to deal with it at the provincial level would be problematic since the Constitution Act of 1867 gives the Federal Government clear jurisdiction over all Canadian fisheries waters, including the territorial seas and all inland waters.

It is now clear that wording referring to general protection under habitat sections of the Act, in the "Protection" section of status reports accepted and approved prior to 1994 is in error, except for the 11 commercial and/or game species (see Table 1) listed.

## Definitions

In its early days, one of the first problems that the Committee had to deal with was the formulation of a set of definitions of categories to be used. This was a formidable task and it is evident that the inaugural workers gave considerable thought to the process. An overview of each year's status assignments, as exemplified by this subcommittee's reports (see Table 1 in Campbell 1984 through 1994) indicates that the original definitions (see

Cook and Muir 1984) have, in the main, provided an sound basis for status designations.

As the Committee and its work evolved, it became evident that some definitions, or the lack thereof, gave cause for concern. Subsequently in 1988 the category "Rare" became "Vulnerable" with a change in definition and the use of NIAC (Not In Any Category) dropped in favour of an official list (not a category) to be known as "Report Accepted, No Status Designation Required" [RANSDR] (see Campbell 1989, 1990). In 1990, an additional list was created for species for which there was "Insufficient Scientific Information For Status Designation (see Campbell 1991) which became known by is acronym, "RAISIFSD".

However, the use of RAISIFSD, as a list, did not adequately signify the purpose of having such a list...that appropriate jurisdictions attempt to obtain the lacking information in order to facilitate status designation. To that end, the Committee decided to formalize the list as a category at its 1994 meeting. At the same time, some changes in wording to category definitions were made to remove redundancy and make more clear the meaning. Also, in order to once and for all end the confusion regarding RANSDR, a new category was established — "Not At Risk" (NAR) and the use of the RANSDR list dropped. The new definitions, in comparison to the preceding are presented in Table 3. As these changes were made at the 1994 meeting, deliberations at that meeting were based on the existing definitions as reflected in Table 1. Status assignments in future years will reflect the new definitions. Subcommittees have been directed to re-evaluate all species currently listed under RANSDR for recommendations to the next meeting as to the correct listing subject to the new definitions.

## Concluding Remarks

The nine reports included in the following series are reports on the status of the respective species in Canada. Status was assigned by consensus of the COSEWIC Committee based on these reports which are published under the name(s) of the original author(s). The reports have undergone minor editing to provide a brief introduction and some degree of consistency in format and presentation.

## Acknowledgments

The members of COSEWIC and the Fish and Marine Mammal Subcommittee would like to extend their thanks to the various authors who have so generously contributed their time and talents in support of COSEWIC. The Committee also wishes to acknowledge the members of the Subcommittee for their unstinting efforts in reviewing the reports and their helpful comments.

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*Editor's note:* A complete list of designations of the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) to April 1996 for all groups is available from Sylvia Normand, Committee on the Status of Endangered Wildlife in Canada, Ottawa, Ontario K1A 0H3 * Phone: (819) 997-4991.

# The Status of the Eastern Sand Darter, *Ammocrypta pellucida*, in Canada*†

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Holm, Erling, and Nicholas E. Mandrak. 1996. The status of the Eastern Sand Darter, *Ammocrypta pellucida*, in Canada. Canadian Field-Naturalist 110(3): 462–469.

The Eastern Sand Darter, *Ammocrypta pellucida*, is a small slender member of the family Percidae. It is widely and disjunctly distributed in north central North America. The degradation of its preferred sand-bottomed habitat has led to the decline of populations in the United States where it is classified by the American Fisheries Society as Threatened. Many populations have also declined or been extirpated in Canada. Recent collections from lakes Erie and St. Clair, and the Grand, Sydenham, and Thames rivers indicate that some populations still exist in Ontario. It has not been captured in recent sampling in Québec. It is recommended that the Eastern Sand Darter be classified as Threatened in Canada.

Le dard de sable de l'est, *Ammocrypta pellucida*, est un membre, petit et élancé, de la famille des Percidae. Il est très répandu et dispersé dans le centre nord de l'Amérique du Nord. La dégradation des habitats aux fonds sablonneux, qu'il préfère, a provoqué un déclin de populations aux États-Unis, où l'American Fisheries Society l'a classifié "menacé". Beaucoup de populations ont aussi décliné ou sont disparues au Canada. De récents échantillonnages des lacs Érie et St-Clair et des rivières Grand, Sydenham et Thames indiquent qu'il en existe encore des populations en Ontario. Au Québec, il y a absence de données récentes. On recommandent, pour le dard de sable de l'est, le statut de "menacé" au Canada.

Key Words: Eastern Sand Darter, Dard de sable, *Ammocrypta pellucida*, Percidae, threatened, Ontario, Québec.

The Eastern Sand Darter (Dard de Sable), *Ammocrypta pellucida* (Putnam, 1863), belongs to a genus in the family Percidae which includes species commonly known as sand darters because its members are found in large creeks, rivers, and lakes with sandy bottoms. They are small pellucid fishes which are known to bury themselves completely or with only their eyes and snout showing. Scott and Crossman (1973) noted that *Ammocrypta pellucida*, an uncommon species in Canadian waters, has probably declined in abundance from former levels. This report summarizes our current knowledge of the distribution and status of the species in Canada.

## Description

Species in the genus *Ammocrypta* are generally distinguished from other darters (tribe Etheostomatini) by translucent and slender elongate bodies which are usually incompletely scaled. The Eastern Sand Darter (Figure 1) differs from the other six species of the genus in the following characteristics. It is pale white, yellowish or silvery coloured with a series of 10 to 14 lateral dark spots usually located entirely below the lateral line scale row. These spots are slightly smaller than the pupil, and are frequently rounded anteriorly and oblong posteriorly. The median fins are not pigmented. *Ammocrypta pellucida* is one of the most elongate species of *Ammocrypta*, with body depth entering into standard length usually 8 to 9 times. There are usually 10 to 12 transverse scale rows on each side, 4 to 7 of these below the lateral line, and 9 to 11 (usually 10) preoperculomandibular canal pores. The pelvic rays of adult males are darkly pigmented and have small tubercles. Simon et al. (1992) described larval characteristics of five sand darter species, including *Ammocrypta pellucida*. Average adult size ranges from 46 – 71 mm total length (TL), and maximum recorded size is 81 mm TL (from Scott and Crossman 1973; Williams 1975; Trautman 1981).

Although the genus *Ammocrypta* is recognized in the widely accepted *Common and Scientific Names of Fishes from the United States and Canada* (Robins et al. 1991), Simons (1991, 1992) proposes that *Ammocrypta* be downgraded to the subgenus level and that six species within the subgenus, including *Ammocrypta pellucida*, be placed in the genus *Etheostoma*. His study indicates that the genus *Ammocrypta* is not monophyletic, and when reduced to a monophyletic group (by removing one species), *Ammocrypta* exhibits a similar amount of character variation as the other *Etheostoma* subgenera *Boleosoma* and *Ioa*. However, there has been insuffi-

*Reviewed and Approved by COSEWIC 14 April 1994, status assigned — Threatened.
†Contribution number 58 of the Centre for Biodiversity and Conservation Biology, Royal Ontario Museum, Toronto, Ontario.

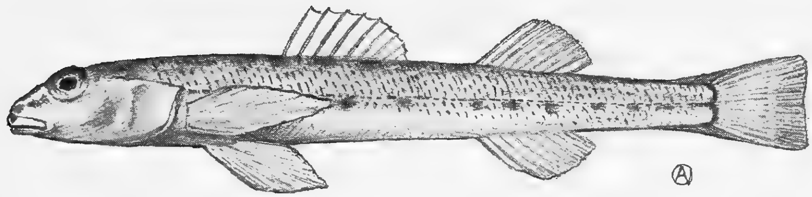

FIGURE 1. The Eastern Sand Darter, *Ammocrypta pellucida* (Putnam), 59 mm TL, Sydenham River, Lambton Co. (ROM 56997). Drawing by Anker Odum.

cient time for this proposed name change to be scrutinized and accepted by the scientific community and the well-established scientific name *Ammocrypta pellucida* is retained here.

## Distribution

In North America, the Eastern Sand Darter has been found in the Ohio River basin in Ohio, Indiana, Illinois, Kentucky, W. Virginia, and Pennsylvania. It has been recorded from the Lake Huron, Lake St. Clair and Lake Erie drainages in Michigan, Ohio, New York, and Ontario. It has not been recorded in the Lake Ontario drainage, but occurs farther east in Saint-Laurent (St. Lawrence River) and Lac Champlain drainages of Québec, Vermont, and New York (see inset, Figure 2). Recent reductions in distribution have been documented in Kentucky (Kuehne and Barbour 1983), Illinois (Smith 1971), Ohio (Trautman 1981), Michigan (Smith et al. 1981), and Pennsylvania (Cooper 1983). Since 1970, *Ammocrypta pellucida* has been recorded at new localities in New York (Smith 1985), Ontario, and Québec.

In Ontario, *Ammocrypta pellucida* was collected prior to 1970 from the Ausable River, the Sydenham River (Kent, Lambton, and Middlesex counties), and the Thames River, Catfish Creek, Big Otter Creek, and Big Creek. It was first collected in the Canadian waters of Lake Erie in 1953 at Pelee Island, and in both eastern and western basins of Lake Erie in 1957. Since 1970, specimens have been collected at new locations in Lake Erie at Rondeau Bay and Long Point Bay, Lake St. Clair, and in the Grand River [see Figure 2 (Appendices of all records are on file and available on request from COSEWIC, Canadian Wildlife Service, Ottawa, Ontario K1A 0H3)].

In Québec, *Ammocrypta pellucida* was collected prior to 1970 in Lac des Deux-Montagnes near Montréal, Saint-Laurent near Sorel, and in some larger tributaries of Saint-Laurent: Rivière Châteauguay, Rivière L'Assomption, Rivière Yamaska, Rivière Saint-François, Rivière Yamachiche, and Rivière Gentilly. Since 1970, specimens have been collected in Rivière Richelieu, Chenal aux Ours (a channel between the Berthier Islands at the western end of Lac St-Pierre), Rivière Becancour, Rivière aux Orignaux, and Petite Rivière du Chêne (see Figure 2).

On the map of Hocutt (1980), one distribution point appears to be on the Canadian side in the St. Lawrence River around Cornwall, Ontario. Since we could not find any capture records in the vicinity of Cornwall, we conclude that this point probably represents the record for the Little Salmon River near Fort Covington, New York (Smith 1985). We were unable to verify the authenticity of a distribution point about 15 km upstream from the only record we have located in Rivière L'Assomption, Québec. According to C. H. Hocutt, D. E. McAllister (editors of the *Atlas of North American Freshwater Fishes* (Lee et al. 1980); and J. D. Williams (U.S. Fish and Wildlife Service Exotic Fish Lab, Gainsville Florida) Canadian distribution records on the map of Hocutt (1980) are based on Mongeau et al. (1974, 1979), Williams (1975), and Mongeau (1979a). The upper L'Assomption River record could not be found in any of these publications.

## Protection

*Ammocrypta pellucida* receives no special protection in Canada (but see **Habitat** section). It is listed as threatened in the United States by the American Fisheries Society (Williams et al. 1989). It is classified as Endangered in Ohio, Michigan, Pennsylvania, and New York and listed as of Special Concern in Indiana and Kentucky (Johnson 1987).

## Population Sizes and Trends

*Ammocrypta pellucida* has declined in, or has been extirpated from, many areas of its North American range. Formerly widespread and abundant prior to 1900, the Eastern Sand Darter displayed a steady decline in abundance between 1925 and 1950 in Ohio. Despite thorough investigations, few specimens were captured after 1955 (Trautman 1981). It has been decimated in the upper Wabash River, a major portion of its former range in Illinois (Smith 1971). Cooper (1983) suggested *Ammocrypta pellucida* has disappeared from the Monongahela drainage in southwestern Pennsylvania. Few populations still survive in New York (Smith 1985).

Kuehne and Barbour (1983) reported declines in Kentucky in the upper Kentucky and Licking rivers. In Canada, populations have declined or been extirpated from several areas. However, recent collections of specimens indicate that Lake Erie, Lake St. Clair, and several rivers in southwestern Ontario and Québec continue to support populations.

Studies have not been specifically conducted to estimate population sizes of *Ammocrypta pellucida* in Canada. However, changes in population size may be inferred from sampling data. Between 1922 and 1958, the Eastern Sand Darter was collected at 13 sites in six rivers (Ausable, Sydenham, Thames, Catfish, Big Otter, Big) in southwestern Ontario. An intensive sampling program was conducted between 1970 and the mid 1980s by the Ontario Ministry of Natural Resources (OMNR), Royal Ontario Museum (ROM), and the Canadian Museum of Nature (Mandrak and Crossman 1992). During this time, the Eastern Sand Darter was collected at seven new sites in three river systems (Thames, Sydenham, Grand). At least six of the 13 sites sampled prior to 1959 in five streams (Ausable, Thames, Catfish, Big Otter, Big) were sampled during this program, but the species was captured at none.

Between 1989 and 1991, ROM surveys specifically targeted suitable sand-bottomed habitats. All 13 sites where *Ammocrypta pellucida* was known prior to 1959 were sampled. It was captured at only three of those sites. Seven sites in three river systems (Thames, Sydenham, Grand), including five of the seven sites where the species was captured between 1970 to 1987, and two new sites were also sampled. The Eastern Sand Darter was found at all of these sites.

A single specimen was collected in a Lake Huron tributary, the Ausable River, in 1928. Subsequent sampling at this site in 1936 and in 1982, and in 1974 at five sites within 5 km of the capture site, failed to collect specimens. Therefore, it probably no longer occurs in the Ausable River.

*Ammocrypta pellucida* has been collected in two Lake St. Clair tributaries. Forty-eight specimens were collected in the Thames River "at Muncey" in 1923 (Hubbs and Brown 1929). Although it was not captured "near Muncey" in a 1941 sampling, it was recorded during sampling downstream from Muncey (the community of Muncey in Gazetteer of Canada, Ontario: 42°49'N, 81°29'W) in the Thames between Wardsville and the Moravian Indian Reserve in 1958 (ROM Accession 482). The Eastern Sand Darter has been collected at four other sites both upstream and downstream of Muncey in the 1970s. The 1989 to 1991 ROM surveys found *Ammocrypta pellucida* at most locations in the Thames River where they had been captured in the past including the upstream and downstream extremes. Therefore, it can be concluded that the range of the Eastern Sand Darter has not been reduced in the Thames River. However, the number of specimens captured in one sampling in 1923 is approximately equivalent to the total number of specimens captured in at least 22 subsequent sampling attempts indicating that its abundance has declined in the Thames River. *Ammocrypta pellucida* was collected in the Sydenham River at Strathroy in 1927, Alvinston in 1929, and downstream at the mouth of one of its tributaries, Fansher Creek, in 1972. It was also captured in the "East Sydenham River" in 1983 (Wilfrid Laurier University 8123). However, no additional locality data for this record were available. Eight collections, made by the ROM at seven sites with sandy bottoms between Strathroy and Alvinston in 1991, failed to capture the Eastern Sand Darter. It was collected in the Sydenham River at and 700 metres below the mouth of Fansher Creek during fish surveys conducted in 1989 and 1991. In 1991, it was captured farther downstream at another location in the Sydenham River. The Eastern Sand Darter still exists in the Sydenham River but because there are no historical data for the Sydenham River downstream of Alvinston, it cannot be determined whether the range of *Ammocrypta pellucida* has been reduced or has shifted downstream.

The Eastern Sand Darter was collected in three central Lake Erie tributaries prior to 1970 and one tributary in 1987. Specimens were collected in Big Creek and Big Otter Creek in 1923 and 1955, and in Catfish Creek in 1922 and 1941. Between 1973 and 1990, four sampling attempts in both Big Creek and Catfish Creek, and nine sampling attempts in Big Otter Creek failed to capture specimens. Therefore, it is probable that *Ammocrypta pellucida* no longer occurs in Big Creek, Big Otter Creek, and Catfish Creek.

In 1987, the Eastern Sand Darter was first captured in the Grand River, at Brantford. The Grand River has been sampled in the vicinity of Brantford between 1966 and 1976 (W. Yerex, Grand River Conservation Authority, Brantford, Ontario; personal communication). However, the site of the 1987 capture of *Ammocrypta pellucida* was not sampled during this period and there is no evidence in records available that it was sampled prior to 1966. This population is 60 km from the nearest known native population in Big Creek. It may be the result of an unrecorded introduction, or a remnant of a formerly wider range fragmented by environmental or cultural impacts. Additional specimens caught in 1991 confirm that this population is established and self-reproducing.

*Ammocrypta pellucida* was first collected in the Canadian waters of Lake Erie at Pelee Island in 1953 (University of Florida 9911). Additional specimens were collected in both eastern and western basins during trawls conducted in 1957 (Scott and Crossman 1973), in Rondeau Bay in 1975, and in the western basin in 1984 and 1985. OMNR index netting trawls in Long Point Bay conducted since 1972, captured specimens every year between 1979 and

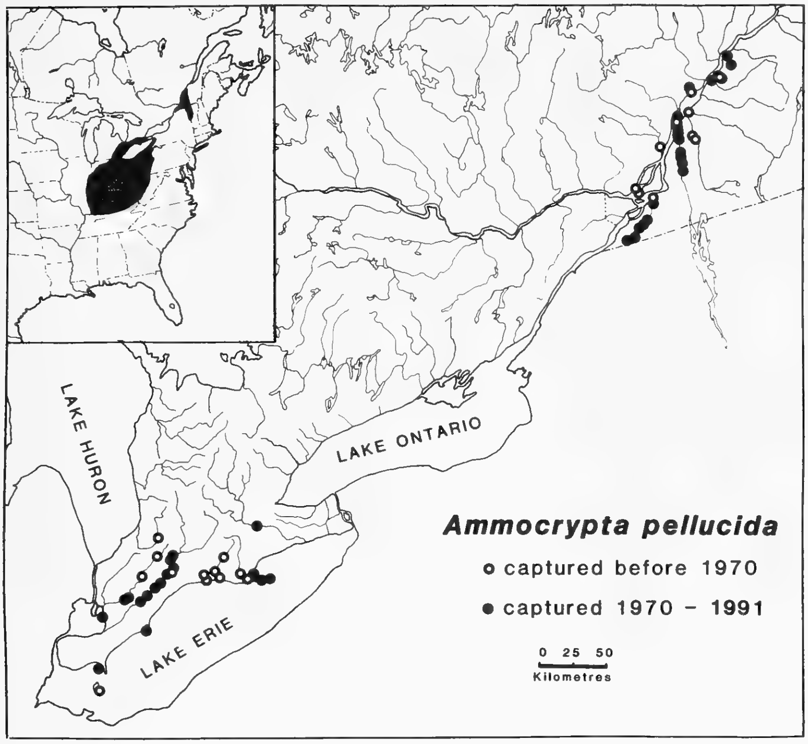


FIGURE 2. Canadian distribution of *Ammocrypta pellucida*, with inset of North American distribution modified from Hocutt (1980).

1987, except 1983. Neither sampling techniques nor personnel had changed in the OMNR index netting program in Long Point Bay (S. Nepszy, Lake Erie Fisheries Research Station, OMNR, Wheatley, Ontario; personal communication). Therefore, the appearance of specimens in Long Point Bay only after 1978 was not the result of changes in expertise of detection or sampling techniques and may represent the establishment of a new population.

The Eastern Sand Darter was first collected in the Canadian waters of Lake St. Clair in Mitchell's Bay by an OMNR small trawl study conducted between 1983 and 1985. The results of the study show an overall decline in numbers of captured specimens (1983 97 specimens, 0.6 specimens/tow; 1984: 66, 0.4; 1985: 26, 0.2). This does not necessarily indicate a decline of *Ammocrypta pellucida* in the lake, as this trend may be the result of other factors such as normal fluctuations in year-class numbers or variations in sampling techniques (Nepszy, personal communication).

Due to the limited sampling of suitable habitats in Lake Erie and Lake St. Clair, it is difficult to determine the present status of Eastern Sand Darter populations at specific locations within these lakes. However, the population in Long Point Bay appeared to be stable during the nine-year period from 1979 to 1987. It is possible that populations of *Ammocrypta pellucida* exist in areas of sandy habitat in lower Lake Huron. These areas have not been sampled by the methods used in Lake Erie and Lake St. Clair (B. Payne, Lake Huron Fisheries Assessment Unit, OMNR, Owen Sound, Ontario; personal communication).

Before 1970, *Ammocrypta pellucida* was collected in southwestern Québec at two sites on Lac des deux Montagnes, one site on Saint-Laurent, and 11 sites on six Saint-Laurent tributaries. Since 1970, it has been collected at one site in Chenal aux Ours, and at 37 sites on seven Saint-Laurent tributaries.

*Ammocrypta pellucida* was collected in Lac des Deux Montagnes in 1941 and 1946. Mongeau and Massé (1976) and Mongeau et al. (1980) did not report its capture in their studies of the waters around Montrèal between 1964 and 1977. A sampling attempt in 1990 by ROM on a shallow, sandy beach at the 1941 site, Anse à L'Orme, failed to capture any *Ammocrypta*. The only recorded capture of the Eastern Sand Darter in Saint-Laurent (not including lake expansions) was reported by Cuerrier et al. (1946). It was not recorded in a 1973 survey of 325

sampling stations in Saint-Laurent between Montréal and Sorel (Massé and Mongeau 1976). Cuerrier et al. (1946) reported that the Eastern Sand Darter was particularly abundant in Rivière Saint-François in the Lac Saint-Pierre region. However, it has not been captured in the Rivière Saint-François since 1944 despite sampling by Service de l'Aménagement de la Faune, Ministère du Loisir, de la Chasse et de la Pêche (MLCP)-Montréal between 1965 and 1975 (Mongeau and Legendre 1976) and in 1991 (Audet and St-Onge 1992). Fourteen specimens were collected at a single site on Rivière L'Assomption in 1969. No specimens were captured at or near this site (Station 4) nor at any of the other 15 sites sampled on this river during electrofishing surveys in 1990. At station 4, the water was described as very turbid and the substrate consisted of 100% clay (St-Onge 1992). The Eastern Sand Darter probably no longer occurs in Lac des Deux Montagnes, Saint-Laurent, Rivière L'Assomption, and Rivière Saint-François.

*Ammocrypta pellucida* was collected at 12 sites on Rivière Châteauguay between 1941 and 1976. Vladykov (1942) reported the capture of three specimens in June 1941 from Rivière Châteauguay near Ste. Philomène village (now Mercier). Cuerrier et al. (1946) later documented the capture in August 1943 of about 180 specimens at a site near the city of Châteauguay. A fish survey of Rivière Châteauguay, where the main course of the river was sampled at approximately 0.32 km intervals from the mouth to the headwaters, was conducted by MLCP-Montréal during 1975 and 1976 (Mongeau et al. 1979). The Eastern Sand Darter was collected at 10 of 287 sampling stations distributed along approximately 55 km of the main course of the river and at one site in one of its tributaries, Rivière Trout. It ranked 31 out of 53 total species in frequency of occurrence in the collections. However, it was not recorded from the city of Châteauguay where it had been previously reported as abundant (Cuerrier et al. 1946). In Rivière Yamaska, *Ammocrypta pellucida* was captured between 1963 and 1971 at four of 120 sampling stations within a 5 km stretch of the river. It ranked 37 out of 59 species in frequency of occurrence in the collections (Mongeau 1979a). No specimens were caught during sampling in the Rivière Châteauguay conducted in 1993 (Nathalie La Violette, University of Toronto, Toronto, Ontario; personal communication). It has been recorded from three sites in Rivière Yamachiche near the mouth in 1944 and 1972. As the result of lack of recent sampling, it is not possible to determine the current status of the Eastern Sand Darter in Rivière Yamachiche. The Eastern Sand Darter was collected at one site in 1941 and at two sites in 1982 in Rivière Gentilly where it likely still exists.

Since 1970, the Eastern Sand Darter has been collected in four additional tributaries of Saint-Laurent, and in Chenal aux Ours (in 1974). It has been captured once at single sites in Rivière Becancour (1981; ROM 42091), Rivière aux Originaux (1982; MacFarlane et Durocher 1984), and Petite Rivière du Chêne (1982; MacFarlane et Durocher 1984). In 1970, *Ammocrypta pellucida* was collected at 19 of 159 sampling stations in a 60 km stretch of the main channel of Rivière Richelieu from McMasterville to its mouth. It ranked 30 of 60 total species in frequency of occurrence in the collections (Mongeau 1979b). In 1974, four specimens were collected at one site less than a kilometre from the mouth of Rivière Richelieu, but at none of the other 481 sites sampled in the Lac St. Pierre region (Massé and Mongeau 1974). Because there has been no sampling since 1982, it is not possible to determine the current status of *Ammocrypta pellucida* in the rivers where it has been captured since 1970.

It is apparent that populations of *Ammocrypta pellucida* in tributaries to the north central shore of Lake Erie, the upper Sydenham River, and the Ausable River have been extirpated. Analysis of the results of sampling after 1958 by ROM, OMNR, and NMC indicate that the decline of populations in Ontario streams occurred prior to 1970. Results of sampling between 1990 and 1993 in Québec suggest that populations in the Châteauguay, Yamaska, l'Assomption and St-François rivers have declined or been extirpated. However, capture results may be affected by differences in sampling gear (the 1990s sampling was conducted using boat and back-pack electrofishers, whereas seine nets were used in earlier sampling). The current status of other populations, is unknown as the result of the lack of recent sampling. Based on recent sampling, populations are considered extant in Lake Erie, Lake St. Clair and its tributaries, the Grand River, and Rivière Gentilly.

## Habitat

The preferred habitat of *Ammocrypta pellucida* is sand-bottomed areas in streams and rivers, and sandy shoals in lakes (Scott and Crossman 1973). It has also been collected over a bottom of "limestone terraces covered with a thin layer of mud" in Rivière Châteauguay (Vladykov 1942), in riffles over rubble and gravel, and on silted sand bottoms in the Sydenham River (ROM 56997). It has been found in waters that are clear, tea-coloured and highly turbid (secchi depth ≥15 cm). In these waters, aquatic vegetation ranged from absent to some submerged macrophytes present, and current ranged from still to swift (unpublished data, ROM).

Siltation associated with agricultural practices has led to the significant reduction of the preferred sand-bottomed habitat of the Eastern Sand Darter. For example, a significant increase in turbidity, indicative of an increased potential for siltation, has been documented in Big Creek as the result of an increase

in cropped area between 1931 and 1961 associated with the introduction of tobacco. Tobacco farming is characterised by a high percentage of exposed ground, which on the Norfolk Sand Plain results in considerable erosion and siltation (Whillans 1977). This impact is not limited to Big Creek, but has likely occurred in all central Lake Erie watersheds where tobacco farming was practised.

Provincial legislation exists that nominally protects the habitat of *Ammocrypta pellucida*. The Ontario Lakes and Streams Improvement Act prohibits the impoundment or diversion of watercourses which leads to silt accumulation. The Land Stewardship II program of the Ontario Ministry of Agriculture and Food (OMAF), designed to reduce the erosion of agricultural lands, has the potential to slow the degradation of remaining critical habitat by reducing siltation. However, this program is voluntary and can only be implemented with the cooperation of landowners. In Québec, habitat is generally protected by the Environmental Quality Act, and may be protected by the Ecological Reserves Act if a species is "threatened with disappearance or extinction." Specific protection can be provided through the Endangered Species Act and conservation laws.

## General Biology

*Reproductive Capability*

Based on a study in the Scioto River drainage in southern Ohio (Spreitzer 1979), *Ammocrypta pellucida* females are ready to spawn at age 1+ if they have reached a standard length of 36 mm. Fecundity is low but comparable to many *Etheostoma* species. Total number of eggs for ova-bearing females ranged from 22 to 829 (mean = 343.1) and the number of mature ova in fecund females ranged from 30 to 170 (mean = 71.0). Larger females produced more eggs. Based on female fecundity and the great disparity in sizes of individuals of the same year class, the 1974 spawning season was protracted, ranging from May to mid-August. Sex ratio was determined to be 1:1 during the entire year, including the spawning season. Water temperature during spawning season ranged from 14.4°C to 24.4°C

In captivity, the Eastern Sand Darter has been observed to spawn at water temperatures between 20.5°C and 23°C. During spawning the male mounts the female, and eggs are deposited when the pair have vibrated and buried their tails and caudal peduncles in the substrate. "Sneaker males" often joined mating pairs (Johnston 1989). A well-oxygenated substrate such as unsilted sand is likely required for high egg survivorship. Spreitzer (1979) suggested that the spawning season was synchronized with low silt levels in the habitat. Examination of the gonads of 17 specimens in the ROM collection indicated that *Ammocrypta pellucida* probably spawns between late June and late July in Ontario.

*Species Movement*

The movements of the Eastern Sand Darter are virtually unknown. Most darters are sedentary, and migrations are rare (Page 1983). However, Johnston (1989) suggested male *Ammocrypta pellucida* may have congregated in an area sampled in the Tippecanoe River, Indiana, in July 1987. Spreitzer (1979) gave evidence that some individuals may migrate to feed when local chironomid population levels are low.

*Behaviour/Adaptability*

The diet of *Ammocrypta pellucida* has been reported to be limited to midge larvae, blackfly larvae and possibly entomostracans by its small mouth size and restricted habitat (Scott and Crossman 1973; Smith 1979; Cooper 1983). In southern Ohio, chironomid larvae comprised an average of 94.4% of the diet of the Eastern Sand Darter. Oligochaetes and cladocerans comprised significant, but smaller, proportions in June and November, respectively (Spreitzer 1979).

Fossorial behaviour is well-developed in *Ammocrypta*. Daniels (1989) provided evidence indicating that burying is an adaptation to maintain position on the relatively homogenous sand beds, particularly during periods of extremely high or low flow. His experiments suggested that *Ammocrypta* does not bury itself to avoid predators or to ambush prey. Low oxygen levels in silted substrate may discourage complete burial, or reduce the length of burial time. This may have a negative survival effect by increasing the amount of energy expended to maintain position in its habitat.

## Limiting Factors

Siltation of critical habitat, impoundments, and deterioration of water quality from effects such as chemical pollution and acid mine drainage, are factors attributed to the decline of the Eastern Sand Darter in Ohio, Illinois, and Kentucky (Smith 1971; Barnes 1979; Trautman 1981; Burr and Warren 1986). Poor water quality near urban areas such as Montréal and Châteauguay, Québec, may have caused its decline or extirpation in those areas (Scott and Crossman 1973). Siltation seems to be the leading cause of significant loss of critical habitat in Canada. Silt reduces the available substrate oxygen, necessary for fossorial behaviour and egg survivorship. It has caused the decline and extirpation of *Ammocrypta pellucida* in some rivers where it was formerly abundant.

## Special Significance of the Species

*Ammocrypta pellucida* is classified as Threatened in the United States and Threatened or Endangered in most U.S. states where it is present. Some *Ammocrypta* (*Ammocrypta beani, Ammocrypta bifascia*, and *Ammocrypta meridiana*) are considered common by Page and Burr (1991). Other species in the genus such as *Ammocrypta clara* and

*Ammocrypta vivax* have been extirpated from parts of their range (see Becker 1983; Robison and Buchanan 1988). Therefore, it can be concluded that the genetic diversity, expressed in behaviour, ecology, and morphology represented in the genus *Ammocrypta* is in jeopardy.

## Evaluation

Population declines will continue in areas where the Eastern Sand Darter is still present, unless the siltation of critical habitat and continued degradation of water quality is prevented. If further siltation and water quality degradation is prevented, populations surviving in areas of remaining critical habitat should stabilize. Extirpated populations may be re-established only if silt is removed from preferred habitat and dispersal from an extant donor population is possible. Due to physical barriers and limited dispersal capabilities, it is unlikely that populations would become re-established naturally in waterbodies without extant populations.

Populations of *Ammocrypta pellucida* in the Grand River and Lake Erie appear to be stable. Many other populations have declined or been extirpated in Canada. The population trend of the remaining populations cannot be assessed due to lack of adequate sampling in the last 10 years. It is likely that all populations will decline or become extirpated if further loss of critical habitat is not prevented. Therefore, until sampling of these populations is undertaken to determine their stability, it is recommended that the Eastern Sand Darter be classified as Threatened in Canada.

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# The Status of the Cutlips Minnow, *Exoglossum maxillingua*, in Canada*†

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Crossman, E. J., and Erling Holm. 1996. The Status of the Cutlips Minnow, *Exoglossum maxillingua*, in Canada. Canadian Field-Naturalist 110(3): 470–477.

The Cutlips Minnow, *Exoglossum maxillingua*, is a stout bodied minnow distinguished from all other members of the family Cyprinidae in North America by its unique trilobed lower jaw. It is common in many upland regions of the Atlantic coast drainage of northeastern North America. It is rare, and there is evidence that populations have declined from levels in the 1930s in Ontario. It is more widespread in Québec where it has been found in numerous river systems from 1935 to 1989. Since 1977, there has been a significant decrease in the number of surveys in the limited area occupied by this species in Canada. Surveys might have provided more information on present status. There is, however, evidence of low and/or declining numbers in some river systems.

Le bec-de-lièvre, *Exoglossum maxillingua*, est un méné au corps trapu qui se distingue de tous les autres membres de la famille Cyprinidae en Amérique du Nord par sa mâchoire inférieure trilobée. Il est répandu dans de nombreuses régions hautes du bassin versant de l'Atlantique dans le nord-est de l'Amérique du Nord. On le rencontre rarement en Ontario, où sa population enregistre une baisse par rapport aux chiffres des années 1930. Il est plus répandu au Québec où l'on a relevé sa présence dans nombre de réseaux fluviaux de 1935 à 1989. Depuis 1977, le nombre d'études effectuées dans la région restreinte occupée par cette espèce au Canada a diminué de façon marquée. Si tel n'avait pas été le cas, nous disposerions probablement de plus de données sur la situation actuelle de l'espèce. Il semblerait toutefois que sa population est faible ou à la baisse dans certains réseaux.

Key Words: Cutlips Minnow, *Exoglossum maxillingua*, Bec-de-Lièvre, cutlips, eye-picker, Cyprinidae, minnows.

The Cutlips Minnow, *Exoglossum maxillingua*, (Lesueur, 1817), is a stout bodied minnow (Figure 1) which can reach a total length of about 150 mm (Pappantoniou et al. 1984a). It can be distinguished from all other North American minnows by its unique trilobed lower jaw consisting of a central bony tongue-like lobe, two lateral fleshy lobes, and no maxillary barbels. The Tonguetied Minnow, *Exoglossum laurae*, the only other species in the genus and known only from the United States, has a lower jaw which is not as obviously trilobed and frequently possesses a maxillary barbel.

Male and female Cutlips Minnows are approximately equal in size and outside the reproductive season there are no obvious external differences between the sexes. During the reproductive season, mature males develop tubercles on the paired fins (Pappantoniou 1983). Larval development of the Cutlips Minnow has been described by Fuiman and Loos (1978) and Buynak and Mohr (1980). The latter reference provides a key to six species of cyprinids, four of which are frequently found in association with *Exoglossum maxillingua* in Canada.

*Exoglossum maxillingua* is currently considered to be derived from *Exoglossum laurae* (Gilbert and Lee 1980). Phylogenetic analysis indicates that the genus *Exoglossum* is most closely related to *Phenacobius*, a genus of minnows restricted to the Mississippi and Gulf of Mexico drainages of the United States (Coburn and Cavender 1992). Geographic variation in four morphometric and seven meristic characters has been investigated using 1247 specimens, including five individuals from the St. Lawrence drainage. Ten characters displayed significant geographic variation between populations, but this variation was not correlated with latitude (Pappantoniou 1983).

## Distribution

The Cutlips Minnow is found in eastern North America (see inset map, Figure 2) in the Atlantic drainage from the St. Lawrence and lower Ottawa river systems in Québec and Ontario south to North Carolina (Gilbert and Lee 1980). It is closely associated with upland areas such as the Allegheny, Catskill and Adirondack mountains and is not found in lowland coastal areas such as most of New Jersey and the Delaware Peninsula.

*Reviewed and approved by COSEWIC 14 April 1994, report accepted, no status designation required.

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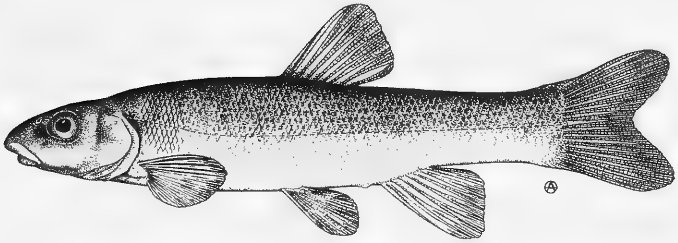

FIGURE 1. Cutlips Minnow, *Exoglossum maxillingua*, 84 mm TL, ROM 9213. St. Lawrence River, Leeds Co., Ontario. Drawn by Anker Odum, from Scott and Crossman (1973), by permission.

Canadian distribution records were obtained from the Service de l'Aménagement de la Faune, Ministère du Loisir, de la Chasse et de la Pêche, Québec (MLCP) [now part of Ministère de l'Environment et de la Faune] in Montréal (240 records), the Canadian Museum of Nature, formerly National Museum of Canada (NMC) (19), the Royal Ontario Museum (ROM) (18), MLCP in Trois Rivières (14), literature (4), a database obtained from the Ontario Ministry of Natural Resources (OMNR; edited by Nick Mandrak, Department of Zoology, University of Toronto and Department of Ichthyology and Herpetology, ROM) (2), and the database of the University of Michigan Museum of Zoology (1). These records were checked for correspondence of locality description and coordinates, entered into a database, and plotted on 1:50 000 maps (all records in the database are listed in an unpublished Appendix on file with COSEWIC and available on request). Records were plotted on a 1:1 000 000 rough base map from which Figure 2 was prepared.

In Canada, *Exoglossum maxillingua* is found in the St. Lawrence River and its tributaries, from a tributary of the Rivière St-Denis near Saint-Pascal, Québec (the northern most record known) upstream in the St. Lawrence River to Ivy Lea, Ontario. It is known from the lower Ottawa River system as far upstream as Rivière du Diable in the Rivière Rouge system (see Table 1, Figure 2). Nash (1908) stated that the species occurred in Lake Ontario. There are no voucher specimens to substantiate its presence in the Ontario portion of that lake but it has been reported from New York tributaries (Crossman and Van Meter 1979).

## Protection

*Exoglossum maxillingua* is not legally protected in North America but it is listed as of Special Concern in North Carolina (Johnson 1987).

In Canada, no specific legislation exists for the protection of this species but laws which incidently protect its habitat include: the Ontario Lakes and Streams Improvement Act which prohibits the impoundment or diversion of watercourses which leads to siltation; the voluntary Land Stewardship II program of the Ontario Ministry of Agriculture and Food which is designed to reduce the erosion of agricultural lands and thus reduce siltation of habitat.

In Québec, habitat is generally protected by the Environmental Quality Act, and may be protected by the Ecological Reserves Act if a species is "threatened with disappearance or extinction." The species has been given little, or no attention, but could be given specific protection under provincial legislation (Endangered Species Act and law on faunic habitats) if required.

## Population Size and Trends

The Cutlips Minnow is reported fairly common in its United States range (Gilbert and Lee 1980). It is particularly abundant in Pennsylvania (Cooper 1983) and New York (Smith 1985).

In Ontario, the Cutlips Minnow has been collected on 14 occasions at 12 different sites (see Table 1). No voucher specimens are known before 1936. *Exoglossum maxillingua* was captured at six sites between 1936 and 1938 from the Delisle River, Lake St. Francis, the St. Lawrence River, and two small tributaries of the St. Lawrence River, Hoasic Creek and an unnamed creek. In 1943, bait dealers considered it to be common in the St. Lawrence around Ivy Lea and in the Delisle River below Alexandria (Toner 1943).

The Cutlips Minnow has not been captured recently at any of the six sites in Ontario where it was taken in the 1930s. Attempts to capture it in Hoasic Creek (ROM Accessions 1276 and 5501) in 1967 and 1989 were unsuccessful. Surveys by the OMNR in the Ontario portion of the Delisle River system in 1973 and 1978 (ROM Accessions 2364 and 3765) also failed to capture the species. Attempts to capture the species in the St. Lawrence River at Ivy Lea in 1967 (ROM Accession 1276) were also unsuccessful. Relatively intensive sampling was conducted by OMNR, ROM and NMC from the late 1960s to

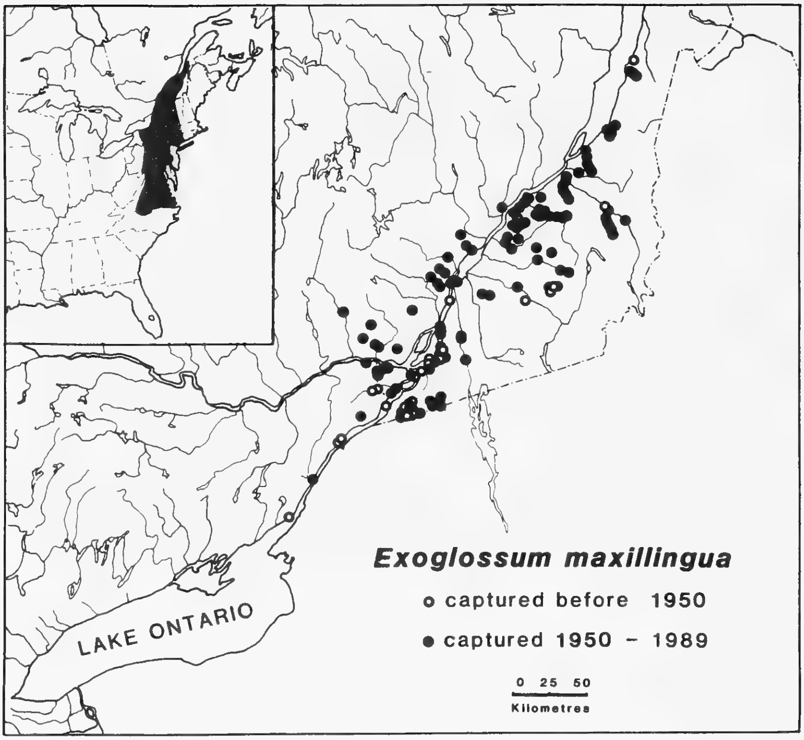


FIGURE 2. Distribution of the Cutlips Minnow in Canada, *Exoglossum maxillingua*. A point may represent more than one capture at different sites within the area of the circle. Inset: North American distribution modified from Gilbert and Lee (1980).

the mid 1980s (Mandrak and Crossman 1992). Despite the much larger scale of sampling, compared to that in the 1930s, the surveys captured the species at only six additional sites in the Raisin River system, Little Rideau Creek, and at one site in the St. Lawrence River. The unsuccessful capture attempts and the scarcity of records after 1970 suggest that populations in Ontario have declined in abundance from former levels.

The species is more widely distributed in Québec where 284 collections have been made at 274 sites. The species was first recorded in 1935 from the upper section of the Ulverton River (Saint-François river system) and in a few streams of the Nicolet system. At that time, *Exoglossum maxillingua* was considered to be one of the rarest minnows in the Eastern Townships (Richardson 1935). In 1941, the species was also recorded from below the Rapides du Rocher Fendu, Lac Saint-Louis, and the Châteauguay, Chaudière, and Saint-Denis river systems.

Surveys conducted by MLCP in several major St. Lawrence River systems from 1960 to 1982 captured the species in many of the rivers where it was formerly known and found it at numerous other sites in the St. Lawrence River of Québec (see Table 1). Distribution records indicate that *Exoglossum maxillingua* occurs at the greatest number of locations in the Rivière Châteauguay system (82 records, 1941 to 1989) and in the St. Lawrence River below Rapides de Lachine in the Montréal region (36 records, 1967 to 1989). In the Châteauguay it is particularly common in the streams of the upper half of the drainage. It ranked 22nd out of 53 different species in relative frequency of occurrence in the collections in a 1975 to 1976 survey of the entire river system (Mongeau et al. 1979). It was captured in 1973 at 20 of 108 seining stations in a 25 km stretch of the St. Lawrence River below the Jacques-Cartier bridge at Montrèal. At a few of these sites it was captured in considerable numbers (Massé and Mongeau 1976). Further upstream, immediately below the Rapides de Lachine, it was captured in 8 of 114 seining stations in 1977 (Mongeau et al. 1980). However, it is not currently considered common in the Montrèal region (Dumont and Roy, personal communication, 1989).

It is moderately abundant in the drainage of the Rivière Chaudière (24 records, 1949-1977), Rivière du Chêne (20 records, 1971), and Rivière Nicolet (13 records, 1935-1977). In other river systems it is not as common. For example, it was captured at only

TABLE 1. Canadian rivers and river systems in which *Exoglossum maxillingua* has been captured 1935-1989. Year(s) of capture are followed by number of distribution records for each year in brackets. Names according to Répertoire Toponymique du Québec (1978. Editeur Officiel du Québec), and Gazetteer of Canada, Ontario (1988, Energy, Mines and Resources Canada. Ottawa). (DR = Division de Rencensement; NL = not listed in gazetteer, underlined records are from Ontario; the rest are from Québec)

| River system | Year (Number of records) |
|---|---|
| Rivière Saint-Denis system | |
| Creek (NL) | 1941(1) |
| Rivière Ouelle | 1964(3),1968(4) |
| Bras Saint-Nicholas | 1975(2) |
| Rivière du Sud | 1964(7) |
| Rivière Etchemin | 1962(1) |
| Rivière Boyer system | |
| Rivière Boyer | 1971(5) |
| Rivière Boyer Sud | 1971(2) |
| Rivière Boyer Nord | 1971(3) |
| Rivière Chaudière system | |
| Rivière Chaudière | 1949(1),1976(3) |
| Rivière Saint-Victor | 1965(8),1971(1) |
| Rivière Beaurivage | 1964(9) |
| Rivière du Cinq | 1977(1) |
| Ruisseau Tring | 1977(1) |
| Rivière du Chêne system (DR: Lotbiniere) | |
| Rivière du Chêne | 1971(8) |
| Rivière Huron | 1971(1) |
| Rivière Henri | 1971(2) |
| Bras d'Edmond | 1971(1) |
| Rivière du Bois Claire | 1971(2) |
| Rivière aux Chevreuils | 1971(5) |
| Creek (NL) | 1971(1) |
| Petite Rivière du Chêne system (DR: Lotbiniere) | |
| Petite Rivière du Chêne 1 | 1982(2) |
| Rivière du Creux | 1982(2) |
| Ruisseau l'Espérance | 1982(1) |
| Creek (NL) | 1982(1) |
| Rivière Sainte-Anne system | |
| Rivière Sainte-Anne | unknown (between 1979-1980)(1) |
| Rivière Charest | unknown (between 1979-1980)(1) |
| Rivière aux Orginaux system | |
| Rivière aux Orginaux | 1982(3) |
| Ruisseau Santorio | 1982(1) |
| Rivière Gentilly system | |
| Rivière Gentilly | 1982(3) |
| Rivière Gentilly Sud-Ouest | 1982(1) |
| Rivière Bécancour | 1964(1) |
| Rivière Yamachiche | 1972(6),1973(1) |
| Rivière Nicolet system | |
| Rivière Nicolet | 1977(3) |
| Rivière Nicolet Centre | 1977(1) |
| Rivière Nicolet Nord-Est | 1977(1) |
| Rivière Nicolet Sud-Ouest | 1935(1),1977(2) |
| Rivière des Rosiers | 1935(1) |
| Ruisseau Francoeur | 1935(1) |
| Rivière Bulstrode | 1977(2) |
| Creek (NL) | 1977(1) |
| Rivière Saint-François system | |
| Rivière Saint-François | unknown (between 1964 and 1974)(1) |
| Rivière Ulverton | 1935(1) |
| Rivière Maskinongé | 1967(1) |
| Rivière Yamaska system | |
| Rivière Saint-David | 1970(4) |
| Rivière du Chicot system | |
| Rivière du Chicot | 1971(5) |
| Ruisseau Saint-Andre | 1971(1) |
| Creek (NL) | 1971(1) |
| Rivière Bayonne system | |
| Rivière Bayonne | 1971(5) |
| Ruisseau Bibeau | 1971(1) |
| Rivière la Chaloupe | 1971(1) |
| Channels above Lac Saint-Pierre | |
| Chenal aux Ours | 1971(2) |
| Chenal du Nord | 1971(1) |
| Rivière Richelieu | 1965(1),1970(4) |
| Rivière L'Assomption system | |
| Rivière de l'Achigan | 1968(1) |
| Lac Saint-Louis | 1941(2),1942(1) |
| Rivière Châteauguay system | |
| Rivière Châteauguay | 1941(7),1942(2), 1946(2),1960(3), 1961(1), 1963(1),1976(21) |
| Ruisseau Dewitt | 1970(1),1976(2) |
| Creek (NL) | 1977(1) |
| Rivière aux Anglais | 1976(5) |
| Ruisseau Robson | 1976(1) |
| Ruisseau Allen | 1976(4) |
| Rivière aux Outardes | 1976(2) |
| Ruisseau Mitchel | 1963(3),1976(3) |
| Creek (NL) | 1976(4) |
| Rivière Hinchinbrook | 1961(1),1963(2),1976(4),1989(2) |
| Rivière Trout | 1941(1),1976(7) |
| Ruisseau Oak | 1967(1),1976(1) |
| Rivière du Chêne system (DR: Deux Montagnes) | |
| Petite Rivière du Chêne | 1970(1) |
| Lac des Deux Montagnes tributaries | |
| Rivière à la Raquette | 1964(1) |
| Rivière Rigaud | 1964(1),1965(1),1966(1),1972(1) |
| Rivière du Nord system | |
| Lac Saint-Denis | 1966(1) |
| Lac Gémont | 1967(1) |
| Lac La Rivière | 1967(1) |
| Rivière Dalesville | 1976(1) |
| Rivière de l'Ouest | 1975(2),1976(2) |
| Rivière Rouge system | |
| Rivière du Diable | 1968(1) |
| Little Rideau Creek | 1978(1),1989(1) |
| Rivière Delisle | 1936(1),1938(1),1946(1),1970(1) |
| Rivière Baudette | 1970(1) |
| Lake St. Francis | 1938(1) |
| Raisin River system | |
| Raisin River | 1973(1) |
| North Raisin River | 1973(1),1989(1) |
| St. Lawrence creek (NL) | 1938(1) |
| Hoasic Creek (Nash Creek) | 1938(1) |
| St. Lawrence River (from a point downstream of Rivière Richelieu upstream to Ivy Lea) | |
| downstream of Rivière Richelieu | 1971(1) |
| Montrèal-below Rapides de Lachine | '41(2),'67(3),'72(1),'73(20),'77(8),'83(1),'89(1) |
| below Rapides du Rocher Fendu | 1942(1),1980(5) |
| at Cardinal | 1981(1) |
| at Ivy Lea | 1936(2),1937(1) |

four of 159 fishing stations in the Rivière Richelieu in 1970 (Mongeau 1979b). It is known from only two sites in the Saint-François river system (Mongeau and Legendre 1976; Richardson 1935) and from only four sites sampled between 1963 and 1975 in a tributary of the Rivière Yamaska (Mongeau 1979a). It was taken in 1980 from below the Rapides du Rocher Fendu but has not been captured again in Lac Saint-Louis despite attempts in 1965 and 1968 (Mongeau and Massé 1976).

Knowledge of the distribution of the Cutlips Minnow in Quebec increased dramatically. However, little sampling has been carried out since 1977 (P. Dumont and G. Roy, Ministère de l'Environnement et de la Faune, Montreal, Quebec; personal communication). Therefore, because most sites have been sampled only once the current status of most populations in Quebec, is undetermined.

Table 1 summarizes our knowledge of where, in what year, and how frequently *Exoglossum maxillingua* has been captured. It summarizes 298 records representing 286 different sites in 38 river systems, 82 rivers and creeks in those systems, and three lakes. Two sites were sampled on three separate occasions and eight sites were sampled on two separate occasions. Information on sampling effort is not shown but investigators which have this information can use Table 1 to better assess the status of the species in each river system.

## Habitat

In the United States, the Cutlips Minnow is usually found in small to moderately sized clear streams, 4.6 to 15 m in width. It prefers quiet pools or channels with gentle to moderately swift current. It has been found in depths of 0.15 to 1.2 m, in water with temperatures ranging from 0 to 26°C, and over firm bottoms of rubble, gravel, boulders, and cobbles. Instream cover such as large rocks, logs, vegetation, or overhanging banks is an important component of the habitat of this species (Hankinson 1922; Van Duzer 1939; Haase and Haase 1975; Cooper 1983; Pappantoniou 1983; Smith 1985). In Connecticut, total alkalinity ranged from 7 to 137 and hardness 22 to 184 both mg/l equivalent $CaCo_3$. Bottom type (percent occurrence) consisted of stone or rubble (35%), gravel (30%), silt (13%), rock (9%), muck (9%), and sand (4%) (Whitworth et al. 1968).

In Canada, *Exoglossum maxillingua* is found primarily in clear or tea-coloured rivers or creeks, on firm rocky bottoms, frequently mixed with one or more combinations of gravel, sand, and mud. In Québec, they are frequently found on hard clay and shale bottoms (Dumont and Roy, personal communication). Aquatic vegetation is frequently present and water current varies from still to fast, but is most frequently described as slow. It has been found in water up to 26°C in June and July. Streams are usually small with a width of 1-20 m, but populations have also been found where the St. Lawrence River and its lake-like expansions are several kilometres wide. In the St. Lawrence, it was most commonly found at the lower end of rapids. The Cutlips Minnow is also known from lakes at elevations of up to 380 m in the Laurentians in Québec.

## General Biology

There is no information on the biology of Canadian populations, but several studies have been carried out in New York and Pennsylvania. Age at spawning is unknown but sizes are reported. In central New York, nest building by a 76 mm (three-inch) male was reported. However, spawning males usually averaged 102 to 140 mm (4 to 5½ inches). Females were usually not over 76 mm (3 inches). Spawning season in the Susquehannah river system of central New York lasted approximately seven weeks in one year (1930?). It began around 25 May and lasted to the middle of July. Spawning occurred in the daytime, peaking at mid-day and late afternoon at temperatures of 17 to 21.5°C. Length of spawning period varied from one to eight days depending on the period during the spawning season (Van Duzer 1939). Spawning may occur later in Québec. Richardson (1935) indicated that specimens captured in the Eastern Townships in the latter half of August and early September had well-developed ovaries and testes.

In New York and Pennsylvania, females outnumbered males in collections during July 1979 and in monthly collections from the winter of 1979/1980 to the winter of 1980/1981. The ratio of males to females ranged from 1:1.1 to 1:1.8. The lower number of males in the collections was attributed to higher male mortality caused by nest building and defense activities (Pappantoniou 1984a,b).

In suitable areas, nests are often built very close to each other. Observations by Van Duzer (1939) indicated that the nest is built by a lone male. After spawning, it may be driven off by a larger male which may or may not continue nest building prior to spawning. The smaller male may attempt to continue to add stones to the nest or spawn in the absence of the larger male. During spawning from one to 12 females may congregate on one nest, but only one pair spawns at a time.

Age composition of populations in New York and Pennsylvania has been shown to differ considerably. Predominant age classes vary from I+ in eastern Pennsylvania (Pappantoniou 1984a) to III+ in southeastern New York (Pappantoniou 1984b). The following sizes at annulus formation were determined for age classes in the Waccabuc River in eastern Pennsylvania: I, 37 to 52 mm; II, 63 to 81; III, 88 to 108; IV, 110 to 126 (Pappantoniou 1984b). Previous studies indicated that overlap in sizes occur between

year classes (Breder and Crawford 1922; Haase and Haase 1975). Maximum age is usually IV+, but specimens have been found to be V+ in a fertile stream in Pennsylvania (Haase and Haase 1975).

Fecundity varied between 345 to 1177 eggs/female ($\bar{x} = 792 \pm 2$ standard deviations of 281.3) in Waccabuc Creek in southeastern New York. Fecundity was considerably lower in the Titicus River, New York ($\bar{x} = 371.9 \pm 182.6$). The fecundity of the female is apparently not directly correlated with size (Pappantoniou 1983).

Some migration into deeper water may occur in extremely cold or wet winters (Miller 1964). Haase and Haase (1975) found that the numbers of Cutlips Minnows declined in fall collections. During the spawning season, *Exoglossum maxillingua* moves to suitable areas.

*Exoglossum maxillingua* is a relatively specialized bottom feeder, but is apparently able to shift to other food resources when its preferred food is unavailable. Several studies have been conducted on its diet in New York and Pennsylvania (Breder and Crawford 1922; Haase and Haase 1975; Johnson 1981; Johnson and Johnson 1982; Pappantoniou 1983; Pappantoniou et al. 1984a,b). The studies indicated that *Exoglossum maxillingua* consumes a variety of aquatic invertebrates, but chironomids, trichopteran larvae, and oligochaetes are the most important items. Younger individuals consume a much larger proportion of chironomids, whereas older individuals favour larger food items such as trichopterans, oligochaetes and plecopterans. Breder and Crawford (1922) found, in addition to unidentified insect remains (34%) and a large proportion of oligochaetes and polychaetes (30%), the gut contained diatoms and plant remains (15%) which they believed were being digested. Seasonal variation of the benthos was reflected in the diet in the Delaware River in Pennsylvania. When chironomid and trichopteran populations were low in September, they fed more on molluscs (Haase and Haase 1975).

Successful reproduction of the Cutlips Minnow depends on availability of a specific type of habitat. Spawning habitat in the Susquehannah River system in central New York consisted of a firm rubble bottom overlain by an abundance of gravel. Depending on its size, the male selects flat stones with angular margins or thin edges that are 6 to 24 cm wide. Large flat rocks and submerged logs will offer protection during nest-building, spawning, and defence of eggs and fry (Van Duzer 1939). The Cutlips Minnow avoids the stronger current sought by other mound-building cyprinids such as the Creek Chub, *Semotilus atromaculatus*, and the River Chub, *Nocomis micropogon* (Miller 1964). Apparently, current must be sufficiently strong to insure a constant change of water and prevent excessive siltation, but gentle enough to prevent the removal of stones as small as 6 cm.

The Cutlips Minnow is sometimes called the eye-picker because it is known to deliberately attack the eyes of other species. Pappantoniou (1983) suggested that the incidence of eye-picking behaviour in Cutlips Minnows apparently increases with intra-specific density. He suggested that in crowded conditions such as those which occur in pools in the summer, the Cutlips Minnow can increase access to limited resources by attacking the eyes of other species.

## Limiting Factors

The presence of the Common Shiner, *Luxilus cornutus*, may adversely affect the reproduction of the Cutlips Minnow. The Common Shiner has been known to breed on the nest of the Cutlips Minnow while the Cutlips Minnow attempted to spawn. The presence and nervous motion of the shiners on the nest always lessened, and sometimes stopped, the spawning of the Cutlips Minnow. Attempts by the male Cutlips Minnow, occasionally assisted by the female, to drive the shiners off the nest were seldom successful (Van Duzer 1939). Miller (1964) noted, however, that *Exoglossum maxillingua* selects quiet channels not usually frequented by breeding shiners and chubs and spawned in late May, whereas the Common Shiner spawned in the first half of May. However, he also noted that the Common Shiner preferred the nest of the Cutlips Minnow over the nests of the chub, *Nocomis*, and Fallfish, *Semotilus corporalis*.

Nothing is known about the susceptibility of the Cutlips Minnow to predation. Its sluggish nature may make it more vulnerable than other small fishes, but its habit of hiding under rocks and logs and in beds of aquatic vegetation would protect it.

Temperature is probably an important limiting factor. It was noted (Pappantoniou et al. 1984b) that, in general, Cutlips Minnows in New York State were more long-lived and robust than Pennsylvania counterparts. This was attributed to the generally milder climatic conditions in southeastern New York State. Harsher climatic conditions, probably also adversely affects the life-span of Canadian populations. Scott and Crossman (1973) stated that the Cutlips Minnow prefers warm streams. This preference may limit its northward dispersal.

The Cutlips Minnow is probably intolerant of turbidity and excessive siltation, both consequences of agricultural and urbanization activities (Scott and Crossman 1973). Flooding may increase mortality of eggs and fry if they are carried downstream beyond the nest during spawning and early development of the species. Flooding may have caused the reduced 1972 year-class of Cutlips Minnows in the Delaware River in eastern Pennsylvania. High water increases turbidity and scours the benthos which adversely affects food availability (Haase and Haase 1975).

## Special Significance of the Species

The Cutlips Minnow possesses some unique morphological and behaviourial characteristics. Its lips are unlike any other North American minnow. It is known to attack and consume the eyes of other species of fishes, a behaviour useful in experiments on the effectiveness of eye camouflage (Pappanto-niou 1983). This species is one of few minnows which demonstrate post-hatching care of fry (Smith 1991).

## Evaluation

Canadian populations are at the northerly fringe of the range of the species. It has been found in 82 rivers or creeks and three lakes in Ontario and Québec from Ivy Lea, Ontario to Saint-Pascal, Québec (Table 1). Although it has been captured at numerous sites in Québec from 1960 to 1980, most of these waters have not been surveyed in the last 15 years and there is little information on their present status. In Ontario and some areas of Québec, evidence indicates that it has declined. Although the Cutlips Minnow has been found in numerous river systems, it has shown decline in some. Possible reasons for this decline may include both natural and cultural factors such as species competition, predation, flooding, turbidity, siltation, cold temperatures, and over-harvest by bait fisherman.

The species, never abundant in Canada, is rarer in Ontario than Québec. Although surveys in Québec have been limited since 1977 there is no evidence to indicate the species is in decline there (M. Huot, Ministère de l'Environnement et de la Faune, Québec, Québec; personal communication).

Although surveys have been limited since 1977 there is evidence to suggest the species is in decline in Ontario mainly due to habitat degradation and competition with increasing populations of Common Shiners.

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# The Status of the Lake Chubsucker, *Erimyzon sucetta*, in Canada*†

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Mandrak, Nicolas E., and E. J. Crossman. 1996. The status of the Lake Chubsucker, *Erimyzon sucetta*, in Canada. Canadian Field-Naturalist 110(3): 478–482.

The Lake Chubsucker, *Erimyzon sucetta*, is a robust, moderately deep-bodied member of the sucker family with a wide head, blunt snout and small, slightly inferior, protrusible mouth. It has a disjunct North American distribution, and in Canada, is found only in southwestern Ontario. This species is declining in many parts of its range. The most significant threats to the Lake Chubsucker in Canada are the drainage or siltation of its critical habitat. In Canada, it prefers a habitat susceptible to human perturbation, has only been collected in low numbers at few localities, and is at its northeastern range limit. It has been classified as Vulnerable in Canada.

Le sucet de lac, *Erimyzon sucetta*, est un membre de la famille des meuniers, robuste et relativement trapu, avec une tête large, un nez émoussé et une petite bouche protractile, légèrement sous la tête (inférieure). Sa distribution est éparse en Amérique du Nord et, au Canada, on ne le retrouve que dans le sud-ouest de l'Ontario. L'espèce est en déclin dans la majeure partie de son aire de répartition. Au Canada, les pires menaces pour le sucet de lac sont le drainage et la sédimentation dans son habitat principal. Au Canada, il préfère les habitats vulnérables où il y a risque de perturbations humaines; on n'en a récolté que de petits nombres dans quelques localités et il se trouve à la limite nord-est de son aire de répartition. Par conséquent, jusqu'à ce qu'un échantillonnage adéquat soit entrepris pour évaluer la situation des populations canadiennes, on recommande que le sucet de lac ait le statut de "menacé" au Canada.

Key Words: Lake Chubsucker, sucet de lac, *Erimyzon sucetta*, Catostomidae, vulnerable, Ontario.

*Erimyzon sucetta* (Lacepède, 1803), the Lake Chubsucker, belongs to a genus of suckers (family Catostomidae) which includes only three species. It is the only representative of this genus to occur in Canada, and is found only in southwestern Ontario. This report summarizes our current knowledge of the distribution and status of the species in Canada.

The Lake Chubsucker is a robust, slightly compressed fish with a moderately deep-arched back, thick caudal peduncle and wide head with a blunt snout (Figure 1). It has a small, slightly inferior, suctorial, protrusible mouth (Scott and Crossman 1973). The dorsal surface of its body is deep olive to greenish-bronze, the ventral surface is green-yellow to yellow-white. Scales above lateral line are dark-edged giving a cross-hatched appearance. A lateral band, if present, has been documented as continuous in adults (Pflieger 1975; Trautman 1981; Rutherford et al. 1985; Robison and Buchanan 1988), or broken into blotches or transerve bands (Anonymous 1962; Scott and Crossman 1973; Douglas 1974; Page and Burr 1991). Preserved adult specimens from Ontario exhibit both continuous and blotched lateral bands when present. Adult size may reach a maximum of 410 mm total length (TL; Page and Burr 1991), although Ontario specimens seldom exceed 254 mm TL (Scott and Crossman 1973).

A dorsal fin with a short base, fewer than 20 rays and without a rounded or pointed anterior lobe differentiates the genus *Erimyzon* from the genera *Carpiodes*, *Cycleptus* and *Ictiobus*. *Erimyzon* differs from other genera of Catostomidae by the presence of an oblique mouth and absence of a lateral line.

In Canada, the creek chubsucker, *Erimyzon oblongus*, has been reported only in New Brunswick, but not since 1873 (Cox 1896). Cox (1896) erroneously listed this record as *E. sucetta* based on Adams (1873) who listed it as *Moxostomus oblongus* (=*Erimyzon oblongus*). Scott and Crossman (1959) concluded that "it seems highly unlikely that it [*Erimyzon oblongus*] ever occurred in New Brunswick". It is present in the American drainage of the Great Lakes in the tributaries of southwestern Lake Erie and southeastern Lake Ontario; therefore, all *Erimyzon* specimens collected in Ontario should be examined closely for *Erimyzon oblongus*. There are differences in the literature in the description of the distinguishing characteristics between the largely sympatric *Erimyzon sucetta* and *Erimyzon oblongus* (Cook 1959; Scott and Crossman 1973; Douglas 1974; Smith 1979; Trautman 1981; Rutherford et al. 1985; Robison and Buchanan 1988; Page and Burr 1991), probably as

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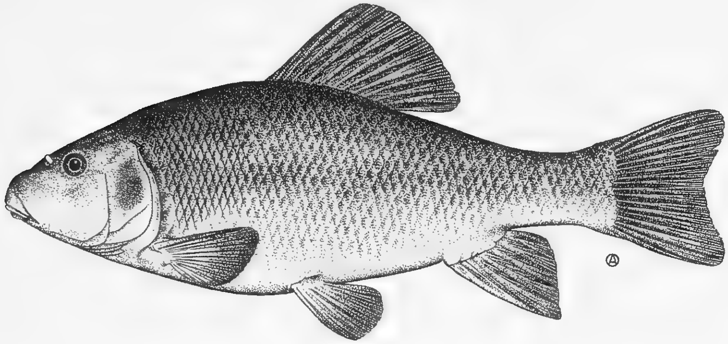

FIGURE 1. The Lake Chubsucker, *Erimyzon sucetta*. Reprinted with permission from Scott and Crossman 1973.

the result of the natural variation of these characters over the geographic ranges of these species. The eye is generally larger in *Erimyzon sucetta* (eye diameter ranges from 3.4 to 6.0 times into head length (HL); 3.2 to 5.2 with 3.0 and 7.2 extremes in the 55 preserved Ontario specimens examined) than in *Erimyzon oblongus* (5.5 to 6.2 times into HL). *Erimyzon sucetta* generally has a lower lateral line scale count (32 to 40; 32 to 40 in Ontario specimens examined) and higher dorsal ray count (10 to 13; 10 to 13 in Ontario specimens examined) than *Erimyzon oblongus* (37 to 47; 8 to 11). *Erimyzon oblongus* is more slender (body depth 3.2 to 4.2 times into standard length (SL)) than *Erimyzon sucetta* (2.4 to 3.2 into SL; 3.0 to 4.0 in Ontario specimens examined). Prior to spawning, male Lake Chubsuckers develop a falcate anal fin and 3 tubercules (a reduced fourth tubercule is occassionally present; Douglas 1974) on each side of the snout (Robison and Buchanan 1988).

## Distribution

*Erimyzon sucetta* exhibits a disjunct North American distribution (see inset map, Figure 2). A southern element is centred around the Gulf States and extends northward from the Arkansas River through the Mississippi Valley to southern Illinois; east of the Mississippi River to the Atlantic Seaboard northward to southern Virginia; and, west of the Mississippi River to eastern Texas. A northern element encompasses a southern Great Lakes drainage. Distribution is fragmented between the two main areas of distribution. Trautman (1981) hypothesized that this fragmentation was the result of northeastern range expansion during the warm Hypsithermal Period (ca. 7000 to 5000 years before present), and subsequent range contraction and fragmentation during the wane of this Period. In recent times, the distribution of *Erimyzon sucetta* appears to be decreasing in many states, and it is now considered extirpated in Iowa and New York (Becker 1983; Smith 1985). However, it was first recorded in Oklahoma in 1982 (Rutherford et al. 1985).

In Canada, *Erimyzon sucetta* has been collected only in the drainages of the Niagara River, and lakes Erie, St. Clair and Huron in southwestern Ontario (Figure 2, all records are listed in an unpublished Appendix to the Status Report on file with COSEWIC Canadian Wildlife Service, Ottawa, in Ontario). Records by Small (1883) for "Hartwell's locks", Ottawa, and by Halkett (1913) for the St. Lawrence River and tributaries are probably erroneous. Hubbs and Brown (1929) felt that the Lake Chubsucker was probably present in Ontario, although none had been collected. Scott (1952) reported that this species was first captured in Ontario in 1949, and suggested that its presence was the result of recent natural migration northward. Mandrak (1990) stated that *Erimyzon sucetta* dispersed through glacial waterbodies into the Lower Peninsula of Michigan and along the south shore of Lake Ontario during the late Pleistocene. Through these, and adjacent glacial waterbodies, the Lake Chubsucker would have had the opportunity to disperse into the lower Great Lakes and subsequently into Ontario. Mandrak (1990) suggested that it was not collected prior to 1949 due to low population numbers and the difficulty of sampling its preferred habitat; therefore, he concluded that the species should be considered native to Ontario. Despite more recent sampling [Appendices containing all records for the species are on file with COSEWIC and available on request (Canadian Wildlife Service, Ottawa, Ontario K0A 3M0)], the Lake Chubsucker was collected only prior to 1970 in Tee Creek, a Niagara River tributary, in Jeanettes Creek, a Thames River tributary, and at the mouth of Big Creek. Despite previous sampling, it has been collected only since 1970 in three tributaries of Big Creek, and the Old Ausable Channel, a Lake Huron tributary. The species has been collected before and after 1970 in Lake Erie at Long Point, Rondeau Harbour, Point

Pelee and in Lake St. Clair. No specimens have been collected since 1983.

## Protection

*Erimyzon sucetta* receives no special protection in Canada (but see "Habitat" section). It is legally protected in New York and Ohio, and is of "Special Concern" in Indiana, Kentucky, Missouri and Wisconsin (Johnson 1987).

## Population Size and Trend

No attempt has been made to determine the population size of *Erimyzon sucetta* in Ontario. Only 30 collections of the Lake Chubsucker have been made in Ontario, and most of these collections yielded fewer than five specimens. Therefore, it is difficult to assess population sizes and trends. The sampling data suggest that populations are stable at Point Pelee where the Lake Chubsucker had been collected in 1949, 1968, 1972 and 1983, and in Rondeau Bay where it had been collected in 1953, 1954, 1955, 1963, 1975 and 1983. Trends in the remaining populations in Ontario are not known.

## Habitat

The preferred habitat of *Erimyzon sucetta* is clear, still, well-vegetated waters, such as those provided by backwaters, bayous, drainage ditches, floodplain lakes, marshes, oxbows, sloughs and wetlands, with substrates of gravel, sand and silt mixed with organic debris (Douglas 1974; Pflieger 1975; Smith 1979; Trautman 1981; Burr and Warren 1986; Robison and Buchanan 1988). In Ontario, the Lake Chubsucker has been captured primarily in heavily vegetated, stagnant bays, channels, ponds and swamps with low turbidity and substrates of clay, silt, sand and organic debris. In 1974, a single specimen was collected in Lyndecock Creek, a Big Creek tributary, in a habitat described as being moderately flowing with abundant floating vegetation over a clay and silt substrate. It is likely that the number and quality of areas containing the critical habitat of the Lake Chubsucker are decreasing, as the result of the draining of wetlands and increases in siltation associated with agricultural practises in southwestern Ontario.

Federal and provincial legislation exists that protects the habitat of *Erimyzon sucetta*. The National Parks Act protects habitat in Point Pelee National Park, and the Ontario Provincal Parks Act protects habitat in Long Point, Pinery and Rondeau provincial parks. The flora, fauna and its habitat in the latter two parks are protected by the Ontario Wilderness Areas Act. The Ontario Lakes and Streams Improvement Act prohibits the impoundment or diversion of watercourses which leads to siltation. The voluntary Land Stewardship II program of the Ontario Ministry of Agriculture and Food is designed to reduce the erosion of agricultural lands. This program has the potential to slow the degradation of critical habitat by reducing siltation.

## General Biology

In North America, the annual spawning season of *Erimyzon sucetta* varies within the period March and July (Cooper 1983). Examination of the gonads of several preserved specimens from Ontario indicated that *Erimyzon sucetta* likely spawns between late April and June in Ontario. At spawning time, the Lake Chubsucker moves to marshes to spawn (Loftus and Kushlan 1987). Depending on the size of the female, between 3000 and 20 000 eggs (Bennett and Childers 1966) are broadcast over submerged vegetation and hatch at water temperatures between 22°C and 29°C (Cooper 1983).

The Lake Chubsucker is omnivorous and its diet consists of plankton, small crustaceans and molluscs, aquatic insects, and filamentous algae and other plant matter which sometimes comprise over 70% of its diet (Cooper 1983; Robison and Buchanan 1988). *Erimyzon sucetta* is tolerant of low $O_2$ levels (Odum and Coldwell 1955; Cooper 1983) and intolerant of siltation, turbidity and high stream gradients (Trautman 1981).

## Limiting Factors

Siltation, increased turbidity and loss of critical habitat are factors attributed to the decline of the Lake Chubsucker throughout its distribution (Lee et. al 1980; Trautman 1981; Burr and Warren 1986). Draining of wetlands and siltation appear to be the leading causes of significant loss of critical habitat in Canada.

## Special Significance of the Species

*Erimyzon sucetta* is declining throughout most of its North American range and is the only representative of its genus presently known in Canada. It can be concluded that the behavioural, ecological and genetic diversity represented by the genus *Erimyzon* is in jeopardy in Canada.

In Canada, the drainage or siltation of critical habitat appear to be the most significant threats to *Erimyzon sucetta*. Population declines will occur in areas where the Lake Chubsucker is still present unless further drainage or siltation of critical habitat is prevented. If further degradation of critical habitat is prevented, extant populations should become stable.

## Evaluation

Populations of *Erimyzon sucetta* at Point Pelee and Rondeau Harbour on Lake Erie appear to be stable. Trends in the remaining populations cannot be assessed due to lack of adequate resampling. In Ontario, it has only been collected in low numbers at few locations, it prefers a habitat highly susceptible to human perturbation, and the populations represent

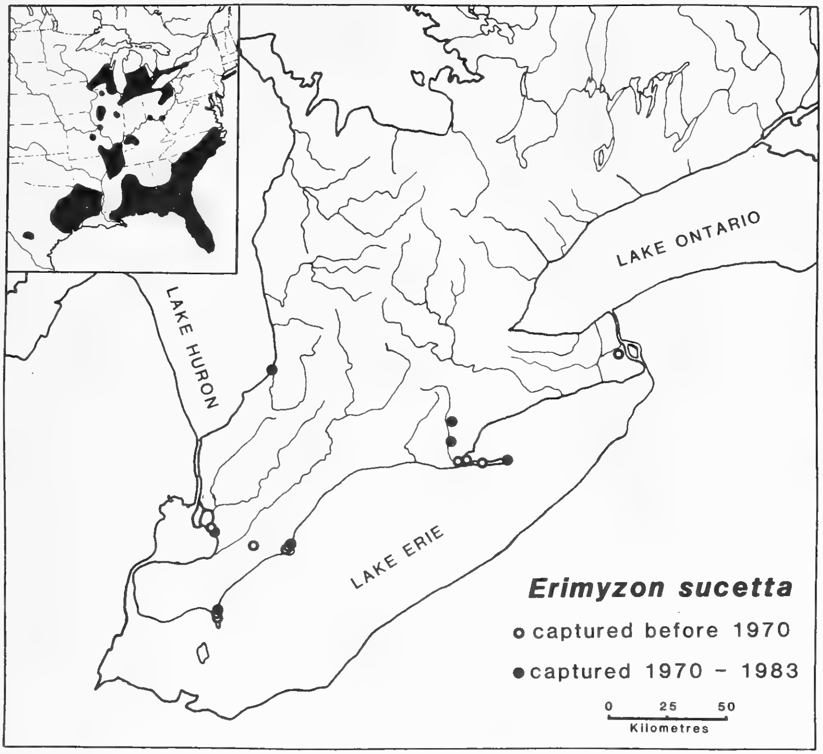


FIGURE 2. Canadian distribution of *Erimyzon sucetta*. Inset map: North American distribution of the Lake Chubsucker (modified from Lee et al. 1980). Note: this species has not been recorded in Canada since 1983.

the northeastern range limit of the species. Therefore, until adequate sampling of these populations is undertaken to determine their stability, it is recommended that the Lake Chubsucker be classified as Vulnerable in Canada.

The choice of status is effected by differences in population trends in protected habitats (e.g., Point Pelee and Rondeau parks) and unprotected habitats (e.g., riverine habitats). It is obvious that the populations in the protected habitats are, by definition, Vulnerable. The unprotected habitats, for which there is poor information, account for a significant portion of the Canadian range of the Lake Chubsucker. As the result of human actions, populations in unprotected habitats may be threatened with imminent extirpation which suggests a status of Endangered. Additional information may lead to a reevaluation of the status assigned.

## Acknowledgments

E. Holm, D. E. McAllister, J. S. Nelson and A. Peden provided useful comments on the manuscript. Financial support for this project was provided by an Environmental Youth Corps grant to EJC, the Royal Ontario Museum, and a World Wildlife Fund grant to EJC. F. Arnaud, K. Dunham, E. Holm and W. Ramshaw assisted with the resampling of some capture sites, and the verification and summary of distribution records. Distribution maps were drawn by W. Ramshaw. Additional distributional data were provided by the Canadian Museum of Nature Ottawa, and the University of Michigan Museum of Zoology, Ann Arbor, Michigan.

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# The Status of the Blackchin Shiner, *Notropis heterodon*, in Canada*

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The native range of the Blackchin Shiner, *Notropis heterodon*, in Canada extends westward from southwestern Quebec to southwestern Manitoba. Little information is available on the biology and ecology of the species and the present status in Quebec is uncertain as recent survey data are unavailable. The species is apparently secure in Ontario, but populations in southwestern Ontario should be monitored as streams in this area are subject to disturbances which could alter water quality as the species appears to be particularly sensitive to turbidity and siltation. Although only recently added to the fauna of Manitoba, the species appears to be native to the province and more widespread and abundant than previously thought.

Au Canada, l'aire de répartition du menton noir, *Notropis heterodon*, s'étend du sud-ouest du Québec jusqu'au sud-ouest du Manitoba. On dispose de peu d'information sur la biologie et l'écologie de l'espèce, et la situation actuelle au Québec est mal connue vu l'absence de données récentes de relevé. L'espèce semble être en sécurité en Ontario, mais les populations du sud-ouest de la province devraient être surveillées à cause des perturbations qui pourraient affecter la qualité de l'eau dans certains couloirs de cette région; ce méné semble particulièrement vulnérable à la turbidité et à l'envasement. On a longtemps cru que cette espèce était une addition à la faune du Manitoba mais, on la considère maintenant, plutôt comme indigène de cette province où elle est plus répandue et abondante qu'on croyait.

Key Words: Blackchin Shiner, *Notropis heterodon*, menton noir, Cyprinidae, minnows, Ontario, Quebec, Manitoba.

The Blackchin Shiner, *Notropis heterodon* (Cope, 1865), is a small cyprinid closely resembling the Pugnose Shiner, *Notropis anogenus*. The Canadian distribution was formerly thought to be restricted to Ontario and Quebec (Scott and Crossman 1973), but is now known to include southern Manitoba (Stewart et al. 1985), where it has been listed as being of special concern (Johnson 1987).

## Description

*Notropis heterodon* (Figure 1) is a small minnow averaging about 64 mm in length. The body is slender and terete straw coloured above and white to silvery below. The scales on the back have darkened edges and there is a prominent black lateral line from the tip of the snout to the caudal fin. The black pigment extends into the chin, accounting for the vernacular name and the black midlateral stripe often has a zig-zag appearance (E. J. Crossman, and E. Holm, Royal Ontario Museum, Toronto, Ontario; personal communication). Spawning fish may develop a pale yellow tinge to the ventral surface (Scott and Crossman 1973) and breeding males develop tiny tubercles on the dorsal surface of the head and the upper surface of the pectoral rays (Trautman 1981). The fins are translucent, the dorsal is sharply pointed and situated above the insertion of the pelvics, the caudal is distinctly forked (see Scott and Crossman 1973; Smith 1979; Trautman 1981; Smith 1985) for definitive descriptions).

The species closely resembles the Pugnose Shiner from which it can be distinguished by the silvery peritoneum and the smaller, upturned mouth of *Notropis anogenus* (Scott and Crossman 1973; Smith 1979). Blackchin Shiners also superficially resemble the Weed Shiner (*Notropis texanus*), differing in the pointed dorsal fin and larger eye, 2 pharygeal teeth on the lesser row on each side and an included lower jaw; the Mimic Shiner (*Notropis volucellus*), where the lateral band is very pale, and does not extend forward to the tip of the snout (Mimic Shiners also have dark pigment at the base of the anal fin), and a pharyngeal tooth count of 0,4-4,0; the Blacknose Shiner (*Notropis heterolepis*), where the lateral band is not as distinct and the pigmentation does not extend to the lower jaw and has 0,4-4,0 pharyngeal teeth and no mid-dorsal black band (Smith 1979). The species may also be confused with the Bridle Shiner (*Notropis bifrenatus*) to which it may be closely related (Gilbert 1980), but the ranges overlap only in Quebec and eastern Ontario.

## Distribution

The range of the Blackchin Shiner is limited to the Great Lakes Basin and the extreme upper Mississippi basin of the northern United States and southern Canada (Figure 2). In the U.S. the species ranges from eastern North Dakota east to New York, probably no further south than 40°N (Scott and Crossman 1973; Gilbert 1980).

*Reviewed and approved by COSEWIC 14 April 1994, report accepted, no status designation required.

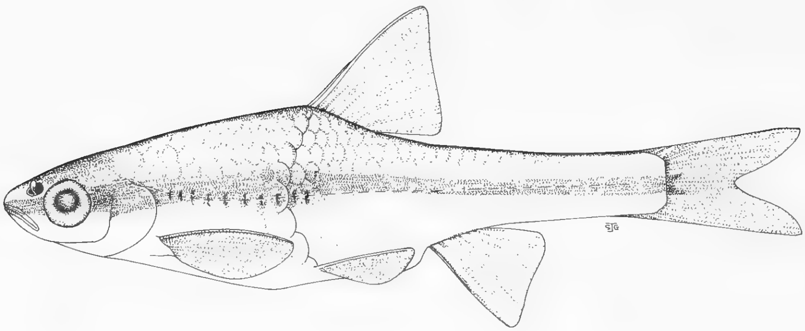

FIGURE 1. Blackchin Shiner, *Notropis heterodon*, [(Gravid female, 50.5 mm (C22 NMC68-0206, 21 July 1968) drawing by Sally J. Gadd, courtesy Don E. McAllister, Canadian Museum of Nature].

In Canada, the species is most widely distributed and abundant in Ontario, although the range more or less extends from the Upper St. Lawrence near Trois-Rivières, Quebec, west to southern Manitoba (Figure 2; Appendices of all records are on file and available on request from COSEWIC).

The species is limited to the extreme southwestern region of Quebec (Figure 2) where it is known from tributaries of the Ottawa River in Hull, Pontiac, Papineau and Gatineau counties, and of the St. Lawrence River as far downstream as Trois-Rivières (Mongeau et al. 1979; Bergeron and Brousseau 1983). Blackchin Shiners have also been collected from the south shore of the St. Lawrence from the Richelieu and Châteauguay watersheds (Mongeau et al. 1974). No Ottawa River collections north of Pontiac County are known, although the species has been recorded from streams on the Ontario side of the river north to at least Temagami (Scott and Crossman 1973; ROM 34900). This perceived absence may be a sampling artifact, since suitable habitat does exist; surveys in the area should be on the alert for this species in any collections made from local streams.

Current Ontario records (Scott and Crossman 1973; Appendices of all records are on file and available on request from COSEWIC) suggest a disjunct distribution (Figure 2). The species occurs in the Ottawa River watershed north to Pembroke and throughout southwestern Ontario in lakes Ontario, Erie and Huron and their tributary streams, north to Sault Ste Marie. Blackchin Shiners have only recently been recorded from Canadian Lake Superior tributaries, Crossman and Holm (personal communication) indicate a collection from the Goulais River (46°45'N, 84°16"W) in 1990 (OMNR 5842). The species has been recorded from several streams in Michigan tributary to Lake Michigan (Scott and Crossman 1973). It is also known in Ontario from the Lake of the Woods watershed, the Rainy River watershed in Quetico Park and the English and Wobigoon river watersheds of the Kenora District of northwestern Ontario (Crossman and McAllister 1986; Stewart 1988). Th[illegible] records from the Hudson Bay, Moose River drainage (Ontario Ministry of Natural Resources L22, L31, L36).

Present knowledge of the Blackchin Shiner also suggests a disjunct distribution in Manitoba (Figure 2), where it was first collected in 1973 (ROM 29840) from Oak Creek, near the junction of the Souris and Assiniboine rivers (Stewart et al. 1985). Further records followed in 1982 from the Assiniboine watershed in Spruce Woods Provincial Park (see Stewart et al. 1985) and from Dauphin Lake (Babaluk and Harbicht 1984). *Notropis heterodon* also occurs in the Winnipeg River in Manitoba and in the Lake of the Woods Watershed, in Falcon Lake Manitoba (Stewart 1988).

## Protection

Blackchin Shiners are not subject to any specific protection in Canada. The species has been considered to be of "special concern" in Manitoba (Johnson 1987), but has not as yet been considered for protection under the provincial Endangered Species Act. In Quebec the species has been given little, or no attention, but could be given specific protection under provincial legislation (Endangered Species Act and laws on faunic habitats).

In the U.S., Blackchin Shiners have been considered to be of "special concern" only in New York State (Johnson 1987), even though it has been eliminated from Ohio waters since 1950 (Trautman 1981), and Iowa (Scott and Crossman 1973). The range is also apparently decreasing in Minnesota and Illinois in concert with habitat loss due to siltation (Eddy and Underhill 1974; Smith 1979).

## Population Sizes and Trends

There is no recent information from Quebec on this species where it is largely known only from

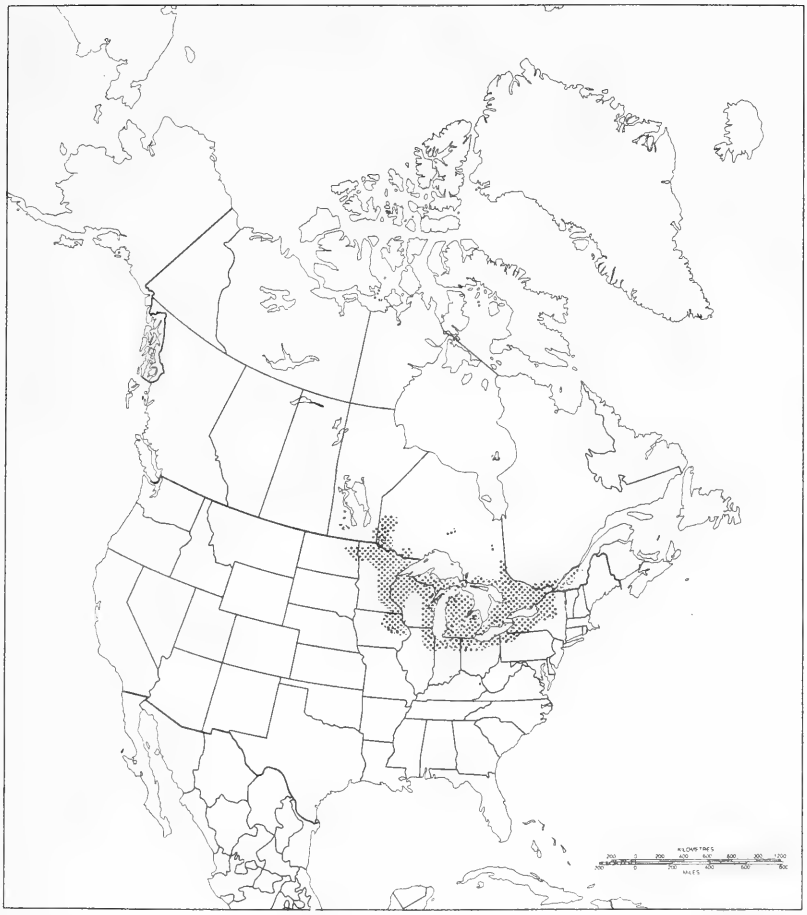

FIGURE 2. North American range of the Blackchin Shiner (*Notropis heterodon*). [Based on NMC, OMNR and ROM collection records and Gilbert (1980)].

presence and absence data (P. Houde, Ministère du Loisir, de la Chasse, et de la Pêche, Direction de la Gestion de la Faune, Hull, Quebec; personal communication). Mongeau et al. (1979) did not find this fish to be common in the Châteauguay system, although it appears to be fairly common in the Ottawa River tributaries of Hull, Pontiac and Gatineau counties (D. E. McAllister, Canada Museum of Nature, Ottawa, Ontario; personal communication). In short, there is insufficient information for an assessment of population sizes and trends of this species in Quebec where no general surveys have been conducted since the 1970s (Houde, personal communication).

The Blackchin Shiner is generally common where suitable habitat (clean, clear, weedy waters) exists (McAllister, personal communication) and is widely distributed in southern Ontario where it appears in some areas in sufficient numbers to be utilized as a bait fish (Scott and Crossman 1973). Although many streams have undergone habitat degredation similar to that responsible for the demise of the species in Iowa and Ohio, there is no direct evidence of a decline in the species in southern Ontario.

The species was not known west of Sault Ste Marie until 1968 when a number of specimens were collected in Quetico Provincial Park (ROM 26052). Since that time, the Blackchin Shiner has been recorded at a number of sites in the Rainy River — Winnipeg River system in the Lake of the Woods area and west into Manitoba (Falcon Lake, Manitoba 49°41'N; 95°19'W) and is apparently abundant where found (Stewart et al. 1985; Stewart 1988). On the other hand, there has been no program of systematic surveys in the province so neither is there evidence to suggest the species is secure.

As in northwestern Ontario, the species was not recorded from Manitoba until 1973 (Stewart et al. 1985), but based on the size of specimens examined and the abundance where found, it has probably been there for some time. Stewart et al. (1985) and Stewart

(1988) discussed the disjunct and scattered populations of this species in Manitoba and concluded that the species was not introduced and entered Manitoba naturally, surviving in areas of suitable habitat. The Dauphin Lake drainage has no direct connection with the Assiniboine River drainage and the species could not have moved naturally between the two in a relatively short time (Stewart et al. 1985). Similar arguments could be made for the dispersal of these fish from Mississippi headwaters to Rainy River headwaters in Minnesota and subsequent downstream dispersal in the Rainy River — Winnipeg River systems in northwestern Ontario and southeastern Manitoba (see Crossman and McAllister 1986). Stewart (1988) further concluded that the absence of the species from the Red River plain in Manitoba suggests westward dispersal through the Manitoba Great Lakes.

As elsewhere, population size and trend information is lacking, but the Blackchin Shiner is apparently abundant where found in Manitoba (Stewart et al. 1985). The fact that it was not recorded in Manitoba and northwestern Ontario until the latter half of this century is probably related to lack of collecting effort and/or confusion with similar species such as the Blacknose Shiner, *Notropis heterolepis*. So far, continued sampling effort has not produced additional records from the Winnipeg/Rainy River system or evidence of the species from the Interlake area of Manitoba, but has revealed the presence of the Weed Shiner in the Interlake region (A. J. Derksen, Fisheries Specialist, Manitoba Department of Natural Resources, Winnipeg, Manitoba; personal communication). As in the U.S.A., the species is sensitive to siltation and may not be able to coexist with the Weed Shiner, since the two species have not been captured together in Manitoba (Derksen, personal communication).

## Habitat

No specific details are available on habitat requirements other than that clear, clean, cool waters with plenty of submerged aquatic vegetation appear to be essential for the success of the species (Trautman 1981; Scott and Crossman 1973). They prefer quiet pools in creeks and rivers and weedy inshore areas of lakes (Scott and Crossman 1973) where the fish are usually found over bottoms of clean sand and/or gravel and quickly disappear when waters become turbid, bottoms silty and aquatic vegetation vanishes (Trautman 1981; Eddy and Underhill 1974; Smith 1979).

There is no information on preferred water temperatures, but the range is restricted to glacial pothole lakes and bays and tributary streams (Trautman 1981; Gilbert 1980). The range does not extend south of the Wisconsonian glacial maxima (Gilbert 1980) suggesting that water temperature may be an important to the success of the species.

Aquatic vegetation probably plays some role in reducing the risk of predation and is probably also a factor influencing the availability of appropriate food items. The diet consists of small crustaceans (cladocerans, copepods and other entomostracans) and small insects (mainly Diptera) taken at the surface (Scott and Crossman 1973; Cooper 1983).

## General Biology

The biology and ecology of this species have apparently not been well studied; there is very little information available on Canadian populations. The species is said to spawn in May to June in Illinois (Forbes and Richardson 1920); however, Smith (1979) indicates that Forbes and Richardson were probably referring to the Weed Shiner, *Notropis texanus*, rather than the Blackchin Shiner. In Wisconsin, spawning occurs from June to August. Gravid females were collected in many samples taken through 9 August, and inspection of ovaries indicated a wide range in egg development. This suggests that spawning may extend over a period of several weeks (Becker 1983).

Blackchin Shiners are short-lived, most in Ohio, not living past two years of age (Trautman 1981). In Ohio young-of-the year fish ranged from 18 to 36 mm by October, immatures 25 to 51 mm and adults 41-71 total length (Carlander 1969). Scott and Crossman (1973) reported that adults from Canadian waters averaged 51 to 61 mm; Stewart et al. (1985) recorded and average total length of 47.1 mm for specimens taken in Spruce Woods Provincial Park, Manitoba in 1982.

The species is considered to be a specialized feeder, due to the terminal position of the mouth (Willsman 1979 in Smith 1985), eating mostly Cladocera and flying insects (small Diptera) taken at the surface (Keast 1965; Smith 1985). There is a progression of foods from young to adult; the young fish feeding on algae and zooplankton while adults prefer larger zooplanters, water fleas and surface midges (Cooper 1983; Keast 1985). In some areas plants, including the algae *Oedogonium* and *Spirogyra*, may constitute a large part of the diet (Rimsky-Korsakoff 1930).

No information on behaviour in the wild is available, although Abrahams and Colgan (1985) have utilized the species in conducting some laboratory experiments related to hydrodynamic benefits from schooling. Parasites of this fish (mostly trematodes and nematodes) have been documented by Bangham and Hunter (1939), Bangham (1955) and Hoffman (1967).

## Limiting Factors

As discussed previously, the species appears to have a narrow range of habitat requirements and responds quickly to changes in habitat and water quality. Trautman (1981) indicated that Blackchin

Shiners disappeared almost immediately from Ohio waters at locations where human or other disturbances resulted in increases in turbidity and siltation or decreased aquatic vegetation. Similar results have been noted in Illinois (Smith 1979), Iowa (Scott and Crossman 1973), and Minnesota (Eddy and Underhill 1974).

Ambient water temperature could also be a limiting factor as the species appears to favour cooler waters of glacial lakes and the headwaters of tributary streams; however, no information exists on the temperature requirements of the species.

Fluctuations in water level may also be limiting. Eddy and Underhill (1974) have observed that Blackchin Shiners are abundant in Lake Itasca (Minnesota) for several years, and then rare for several years, before becoming abundant again. These fluctuations in population seem to correlate with rising and falling water levels due to differences in annual rainfall, high and stable water levels are followed by population increases (Becker 1983)

## Special Significance of the Species

The Blackchin Shiner is probably an important forage species where abundant (Scott and Crossman 1973; Cooper 1983). It is apparently easily maintained in aquaria and has been used as a laboratory species (Abrahams and Colgan 1985).

The disjunct distribution and habitat requirements are of interest to science in relation to the zoogeographic history and distribution of species subsequent to the Wisconsin Period of glaciation. Its critical habitat requirements could also make the species a useful indicator of changing water quality if the previous occurrence at a specific site were known.

## Evaluation

The Blackchin Shiner has a relatively wide distribution in Canada from southwestern Quebec to western Manitoba. There is insufficient information on which to determine the status of the species in Quebec, but it may be secure, at least in streams tributary to the Ottawa River which have undergone little or no disturbance since the last surveys undertaken in early 1970s. However, directed surveys are required to verify both this status and that no chemical or physical changes have occurred within the aquatic habitat.

There is no evidence that Ontario populations are in decline, although those of southwestern Ontario should be surveyed on a regular basis. Streams in this region are subject to a variety of human disturbances which could affect critical habitat resulting in demise of the resident stocks.

The species has been designated as being of special concern in Manitoba (Johnson 1987), based on earlier (prior to 1985) information indicating the presence of the species at only one location in the province, i.e., from Oak Creek, near Treesbank. During the 1980s, the species was found to occur in abundance at several other locations (Babaluk and Harbicht 1984; Stewart et al. 1985; Stewart 1988) and might exist in other suitable habitat (continued sampling has not as yet provided additional records) as well. Given that its occurrence in Manitoba is of long standing and that it previously escaped detection for a variety of reasons, there appears to be no reason why the Blackchin Shiner should not be considered to be a naturally occurring species there.

The Blackchin Shiner is of special concern in Manitoba because its distribution is mostly in agricultural areas of the Province; e.g., the small oxbow lakes along the Assiniboine River and the tributaries of Lake Dauphin. These areas are vulnerable to activities such as drainage works, channelization, damming, etc.

At the present time, there is no indication that the overall status of the species in Canada is at risk or a COSEWIC listing would be appropriate. However Manitoba populations are of special concern and more information is required on the status of the species in Quebec.

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# The Status of the Rosyface Shiner, *Notropis rubellus*, in Canada*

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Houston, J. 1996. The Status of the Rosyface Shiner, *Notropis rubellus*, in Canada. Canadian Field-Naturalist 110(3): 489–494.

The Rosyface Shiner, *Notropis rubellus*, is a small cyprinid with a Canadian distribution from the upper St Lawrence drainage of southwestern Quebec west through southern Ontario to southeastern Lake Superior. Other populations have been reported from the Whitemouth-Birch River system in southern Manitoba. The biology and ecology of the species has not been studied in Canada and abundance information is limited to records of occurrence, but outside of the Manitoba population, which is of concern, the species is not at risk.

Le tête rose, *Notropis rubellus*, est un petit cyprinidé dont l'aire de répartition au Canada s'étend depuis l'amont du bassin versant du Saint-Laurent, dans le secteur sud-ouest du Québec, jusqu'à l'extrémité sud-est du lac Supérieur et englobe le sud de l'Ontario. D'autres populations ont été signalées dans le système des rivières Birch et Whitemouth, au sud du Manitoba. Au Canada, ses caractéristiques biologiques et écologiques n'ont pas été étudiés et l'abondance de l'espèce est limitée aux nombres de mentions, mais l'espèce n'est pas en péril, sauf la population du Manitoba, qui a l'égard particulière.

Key Words: Rosyface Shiner, tête rose, *Notropis rubellus*, Cyprinidae, southwestern Ontario.

The Rosyface Shiner, *Notropis rubellus* (Agassiz 1850), is a small cyprinid found in Canada from the upper St Lawrence river in the east, to extreme southeastern Lake Superior with a northwest extension of distribution reaching southern Manitoba in the west (Scott and Crossman 1973). Information is lacking on relative abundance of the species in Canada, but it is widely distributed in the central part of the range. Since it has a limited distribution in Manitoba (Hinks 1943; Fedoruk 1969), which is separated from the nearest location in Ontario by some 900 to 1000 km, Derksen (A. J. Derksen, Fisheries Specialist, Manitoba Ministry of Natural Resources, Winnipeg, Manitoba; personnel communication to Chairman, COSEWIC Fish and Marine Mammal Subcommittee) suggested that it should be considered for COSEWIC review.

## Description

This fish has a typically slender, elongate body (Figure 1), adults do not usually grow larger than 75 mm in standard length (Gilbert and Burgess 1980) or 89 mm in total length (Trautman 1981), averaging 51 to 76 mm in total length (Scott and Crossman 1973). The species is closely related to, and resembles the Emerald Shiner, *Notropis atherinoides*, and the Silver Shiner, *Notropis photogenis*. Clay (1975) indicated that the similarity of the Rosyface Shiner to the Emerald Shiner has led to erroneous identifications and some old records may be misidentifications. Adults of the species can be separated from the Emerald Shiner as the body of the latter is deeper and more compressed the origin of the dorsal fin is slightly posterior to the pelvic insertion, and the snout is blunt and shorter (Clay 1975; Smith 1985). The body is usually deeper and more compressed and there is no red colouration on breeding adults; the dorsal surface is usually not as darkly pigmented. It can be separated from the Silver Shiner by its latter's nine pelvic rays, prominent middorsal stripe, more anterior position of the dorsal fin, and the dark crescents between the nostrils (Smith 1985).

In the Rosyface Shiner the anal fin typically has 10 or 11 rays, the dorsal fin is usually located about midway between the base of the caudal fin and the preopercle. The caudal fin is moderately forked with rounded lobes, the origin of the anal fin is located in line with the base of the last dorsal ray, and the pelvic origin and insertion are considerably anterior to the dorsal origin. The pectoral fins are low on the body and well forward, the length and width is greater in males than in females (Becker 1983). The lateral line is complete and somewhat decurved towards the anterior. The mouth is terminal, large and slightly oblique. Proportional measurements and counts are summarized in Scott and Crossman (1973) and Smith (1985).

The normal colouration of the fish is overall silvery with slight olivaceous colouration dorsally and silvery white ventrally, the fins are transparent. Breeding males develop 100 or more tubercles on the upper half of the head from snout to occiput (Becker 1983) and the anterior rays of the pectorals; a few may occur on the opercles and the scales along the lateral line. Tubercles may also be found on the upper surfaces of the pelvic, dorsal and anal fins

*Reviewed and approved by COSEWIC 14 April, 1994, status assigned — Vulnerable, Manitoba.

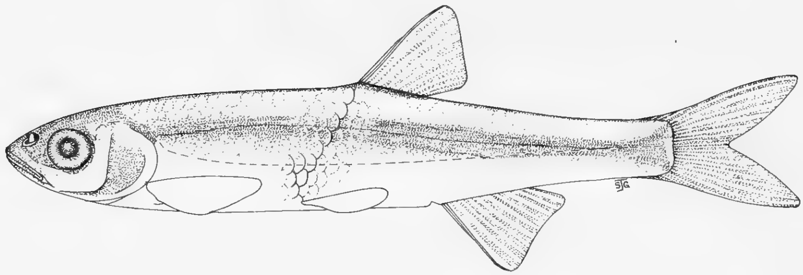

FIGURE 1. Rosyface Shiner, *Notropis rubellus,* NMC 64 0203, approximately 80 mm. Drawing by Sally J. Gadd, courtesy D. E. McAllister, Canadian Museum of Nature.

(Scott and Crossman 1973). Breeding males display orange to brick red colouration of the head (hence the name, Roseface Shiner) to the nape of the neck with the rest of the body being light orange to orange-yellow (Becker 1983). The opercle, sides and ventral surface to the anal fin are a lighter red and the pectoral, pelvic, dorsal and anal fins may be diffused with red. Females may also develop this red colouration, but it is generally paler than on the males and may be absent (Becker 1983); they may also develop tubercles on the head (Pfeiffer 1955; Scott and Crossman 1973; Smith 1985).

## Distribution

Rosyface Shiners are found in central and eastern North America (Figure 2). In the east, the limit of the range is the upper St Lawrence River drainage of southern Quebec, south through New York and Vermont to the James River drainage of Virginia, but excluding the Delaware. The range extends west through most of the Great Lakes drainage (excluding most tributaries to the north shore of Lake Superior) to the Red River of the North drainage in Minnesota and north into Manitoba. West of the Appalachians it occurs in the upper Ohio and Mississippi River basins from Pennsylvania, possibly to North Dakota (one location record from the Sheyenne River), Minnesota and Iowa. East of the Mississippi it is found south to the Tennessee River drainage of North Carolina, Tennesse and Alabama and west of the Mississippi in the Ozark uplands of Arizona, Oklahoma and Kansas to southern tributaries of the Missouri River in Montana (Scott and Crossman 1973; Gilbert and Burgess 1980).

In Canada, the species is most widely distributed in Ontario, although the range more or less extends from the upper St Lawrence near Quebec City, west to southcentral western Manitoba (Figure 2), with a hiatus on the north shore system of Lake Superior. The Manitoba records look unusual only if we look at the Canadian populations in exclusion of the distribution in Iowa, Wisconsin, Minnesota and the Dakotas.

The species is limited to the extreme southern region of Quebec (Figure 2) where it is known from tributaries of the Ottawa River north and west at least to the Black River (Bergeron and Brousseau 1983), and of the St Lawrence River as far downstream as the Nicolet River at the eastern end of Lake St Pierre, just upstream of Quebec City (Mongeau et al. 1974; Mongeau et al. 1979; Bergeron and Brousseau 1981). Rosyface Shiners have also been collected from the south shore of the St Lawrence from the Richelieu and Châteauguay rivers and other St Lawrence River tributaries east to Leclercville on the River Grande (ROM 42159, 46°34'25"N, 71°59'41"W; Mongeau et al. 1974). The Quebec distribution appears to be restricted to the St Lawrence and Ottawa River drainages south of a line at approximately 46 N.

In Ontario, the species occurs in southwestern Ontario (Figure 2) in streams draining into lakes Ontario, Erie, Huron and the eastern end of lake Superior and the Ottawa River watershed north to about the Mattawa River (Scott and Crossman 1973), as in Quebec at a line approximately at 46° N [i.e., the Great Lakes watershed and not found in the Hudson, James or Ungava Bay (Arctic watersheds)]. Rosyface Shiners have not been recorded from north shore Lake Superior tributaries, although they have been recorded from several streams in Michigan tributary to that lake (Scott and Crossman 1973; Smith 1979). Hinks (1943) referred to the species as occurring in the Lake of the Woods watershed, but there are no known records to support the statement. The species should be looked for there as suitable habitat exists and other cyprinids with similar habitat requirements and distributions, such as *Notropis heterodon*, previously not known west of Sault St Marie have recently been recorded from the Rainy River watershed in Quetico Park and the Wabigoon River watershed of the Kenora District of northwestern Ontario (Crossman and McAllister 1986; Crossman 1986; Stewart 1988).

Literature records of the presence of the species in Manitoba where it is known (A. J. Derksen, Fisheries Specialist, Manitoba Department of Natural Resources, Winnipeg, Manitoba; personal communication) from the Whitemouth-Birch river systems (tributary to the Winnipeg River which it joins above an historically impassable falls) go back at least to Hinks (1943). However, this record is uncertain as he

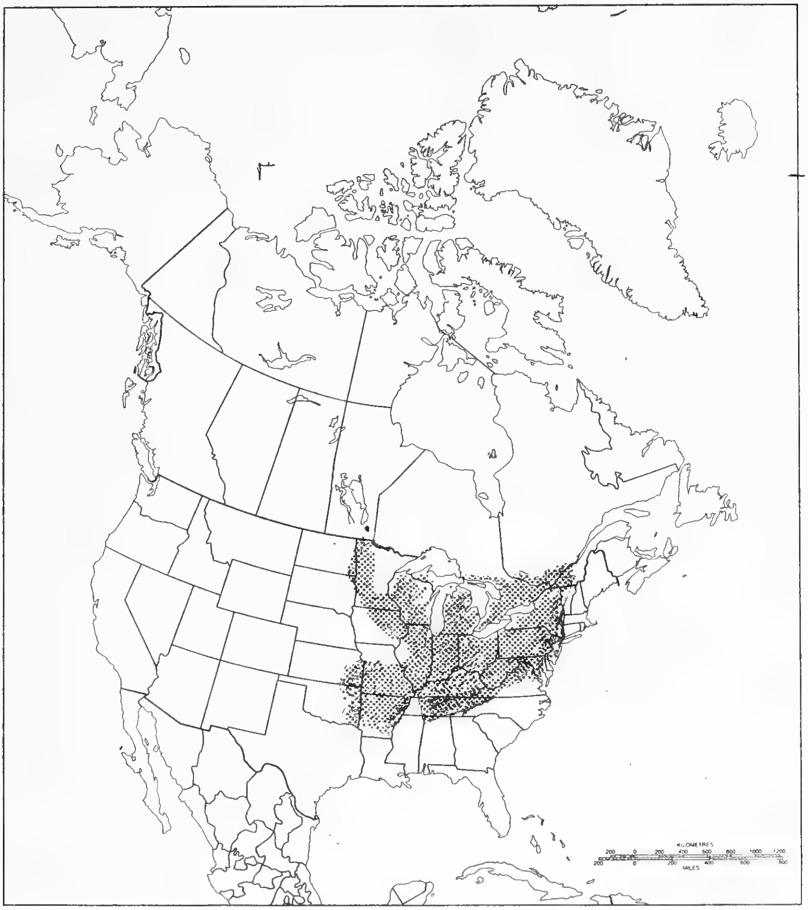

FIGURE 2. North American range of the Rosyface Shiner, *Notropis rubellus*, (from sources cited in the text).

bases the species presence on unsupported evidence that it occurred in the Lake of the Woods system. Fedoruk (1969) also lists the species among the fauna of Manitoba, but he did not give the distribution of any species. Scott and Crossman (1973) included its distribution in Manitoba as in the Red River in southern Manitoba, perhaps based on a 1955 collection by J. J. Keleher from the Whitemouth River at Whitemouth, Manitoba, catalogued at the Royal Ontario Museum (ROM 17539), but more likely because of the reports of the species from the Red River Basin in Minnesota (Derksen, personal communication). The species does not occur along the axis of the Red River in Manitoba (K. Stewart, Department of Zoology, University of Manitoba, Winnipeg, Manitoba; personal communication). No other reliable literature records are known, although the species has been collected several times since from the Whitemouth and as recently as 1984 (ROM 45731; NMC 84-0010, NMC-85-0002). A previously unreported 1976 collection from Lake Manitoba, at Delta Marsh (50°12'00"N, 98° 20'00"W), catalogued in the Canadian Museum of Nature Collection (NMC 76-0421), has been re-examined and identified as *Notropis atherinoides*, not *Notropis rubellus* (B. Coad, Canadian Museum of Nature, Ottawa, Ontario; personal communication).

## Protection

Rosyface Shiners are not subject to any specific protection in Canada, but general protection is afforded, if required, in Manitoba through the provincial Endangered Species Act. In Quebec, the species has been given little, or no attention, but could be given specific protection under provincial legislation (Endangered Species Act and law on faunic habitats) if required.

In the U.S., Rosyface Shiners are considered to be of "special concern" only in the states of Mississippi, North Carolina, North Dakota and South Dakota and is given protected status in Tennessee (Johnson 1987). It has been extirpated from most Ohio waters

since 1950 (Trautman 1981) and is in decline in Minnesota and Illinois in concert with habitat loss due to siltation (Eddy and Underhill 1974; Smith 1979). However, forms of the species have developed in the Pecatonica and Sugar river basins of Wisconsin which are capable of withstanding considerable turbidity (Becker 1983).

## Population Sizes and Trends

There is no recent information from Quebec on this species where it is largely known only from presence and absence data (P. Houde, Ministère du Loisir, de la Chasse, et de la Pêche, Direction de la Gestion de la Faune, Hull, Québec; personal communication), although a few incidental collections in the 1980s did note the presence of the species at some locations where it had been recorded earlier (Appendices of all records are on file and available on request from COSEWIC). Mongeau et al. (1979) found this fish to be abundant where found and Mongeau et al. (1979) found it to be common in the Châteauguay system, and it appears to be fairly abundant in the Ottawa River tributaries of Hull, Pontiac and Gatineau counties (McAllister and Coad 1974). The species is widely distributed in southern Ontario, collection records of the Royal Ontario Museum (ROM, Canada Museum of Nature (NMC) and the Ontario Ministry of Natural Resources (OMNR) indicate that the species is usually numerous where found. There is no direct evidence of a decline in the species in southern Ontario where it has recently been recorded from the same streams where found earlier this century. Many of these streams, particularly in southwestern Ontario, have undergone habitat degradation similar to that responsible for the demise of the species in Minnesota, Illinois and Ohio. On the other hand, there is no evidence to suggest the species is secure, although the species is generally common where suitable habitat (clean, clear, weedy waters) exists (McAllister, personal communication). The species is not known in Ontario west of Sault Ste Marie, but it should be looked for in Quetico Park [not found there in the ROM surveys (Crossman 1976)] and the Rainy River — Winnipeg River system in the Lake of the Woods area, and west into Manitoba where similar species such as the Emerald Shiner, have recently been recorded (Scott and Crossman 1973).

Although listed among the fishes of Manitoba by Hinks (1943), the first verified record of the species appears to be the 1955 collection by Keleher in the Whitemouth River (ROM 17539). The species is apparently abundant in this system (Derksen, personal communication).

Stewart et al. (1985) and Stewart (1988) discussed the disjunct and scattered populations of the Blackchin Shiner, *Notropis heterodon*, in Manitoba and concluded that the species has been there for some time, but had gone unreported through lack of collecting effort and/or confusion with other species. Similar arguments could be made for the dispersal of *Notropis rubellus*. This species like several others (Crossman and McAllister 1986) occurs mainly in the most southerly regions of the Hudson Bay system and gets into Canada only as far as the Whitemouth River and are non-existent north of this. These fishes are warm water adapted and have only recently (in geological time) arrived at their northerly limit or are probably still limited in their northward extensions by temperature preferences. Some species like the Rosyface Shiner have extended their range north only while others like the Blackchin have extended east to Lake of the Woods and Quetico (Crossman and McAllister 1986).

The fact that the Rosyface Shiner was not recorded in Manitoba until the latter half of this century might be related to lack of collecting effort and/or confusion with similar species such as the Emerald Shiner [the Silver Shiner, is known in Canada only from southwestern Ontario (Baldwin 1988)] which is common in southern Manitoba (Scott and Crossman 1973). Continued sampling effort may produce additional records from the Winnipeg/Rainy River system and could provide evidence of the species from the Interlake area of Manitoba. However, Ken Stewart of the University of Manitoba has conducted extensive collections in and around the Winnipeg River and the Interlake area. So far these efforts have failed to turn up Rosyface Shiners in any of these areas, or in streams adjacent to the Whitemouth River (Derksen, personal communication).

## Habitat

The typical habitat of the species is clear, fast flowing larger streams and small rivers over substrates of clean gravel (Gilbert and Burgess 1980). Generally said to avoid small and\or sluggish streams (Clay 1975), it is often found in schools in riffles and clear pools in the lower portion of streams near the confluence with larger streams or rivers (Scott and Crossman 1973; Smith 1979) where aquatic insects are plentiful. It is intolerant of turbidity and siltation (Trautman 1981).

Water temperature tolerances are not known, but Crossman and McAllister (1986) list this as a fish of warm waters, and water temperature may be limiting to its Canadian range which is the northern limit for the species. However, Smith (1979) suggests it is intolerant of high summer water temperatures. Clear, silt free pools and water temperature of at leat 21°C seem to be critical for spawning activity in New York (Pfeiffer 1955).

## General Biology

Apparently the biology and ecology of Canadian populations of this species have received little or no attention. The species has received some attention in the U.S. where it is more widely distributed.

In New York State, Rosyface Shiners spawn in late June when water temperatures are between 2l to 25°C (Pfeiffer 1955). In Illinois, Pennsylvania and Ohio

spawning occurs in late May and early June (Reed 1957a; Smith 1979; Trautman 1981) and may continue into late June (Reed 1957b). Reed (1957a) noted that spawning in Pennsylvania occurred at water temperatures of 20 to 22°C. Spawning occurs in shallow water over gravel in riffles (Pfeiffer 1955; Reed 1957a; Trautman 1981). Becker (1983) mentions that spawning occurred during bright sunny days in shallow water area containing nests of minnows. Pfeiffer (1955) and Becker (1983) provide detailed descriptions of spawning behaviour where schools of eight to 12 fish rush into the spawning area, the males colliding with females. During these brief (5 to 6 second) sessions the fish vibrate over a depression in the gravel and the eggs are released and fertilized. Reed (1957b) noted that later spawnings involved smaller groups of fish with a preponderance of males.

Rosyface Shiners apparently spawn over the nests of *Nocomis* spp. (Reed 1957a) and *Luxilus cornutus* (Becker 1983). Hybrids involving *Notropis rubellus* and *Luxilus cornutus* are well documented in the U.S., and six collections of *Luxilus cornutus* X *Notropis rubellus* are catalogued in the ROM collection (E. J. Crossman, Royal Ontario Museum, Toronto, Ontario; personal communication). According to Smith (1979) this fish spawns over the nests of sunfish, but hybrids with sunfish are unknown and unlikely. There is a record between *Notropis rubellus* and *Notropis volucellus* (Bailey and Gilbert 1960). Rosyface and Silver shiners are often associates and spawn on the same riffles (Trautman 1981); however, the Silver Shiner spawns later (late June to early July in Ohio) and hybridization is unlikely.

The development of young fish has not been well documented; however, Reed (1958) found that hatching occurred in about 60 hours at 20°C and Pfeiffer (1955) found 5 mm fry eight days after spawning. The fish are apparently mature at one year of age (males and females); one year old females were found to have 600 eggs on average (egg diameter being 1.1 to 1.5 mm) and three-year-old females averaged 1175 (Pfeiffer 1955), the eggs are demersal and sticky (Becker 1983). The males appear to grow faster than the females in the first year while the females grow faster in the second and third years. The maximum age is apparently three years (Pfeiffer 1955).

Rosyface Shiners are omnivorous; aquatic insects making up about 72% of the diet (Reed 1957b); algae, diatoms and inorganic material making up the remainder. Smith (1985) reported that aquatic and terrestrial invertebrates account for about 92% of the food.

Parasites of this species are listed by Hoffman (1967). There is no information on utilization by other fishes for forage.

## Limiting Factors

The species appears to have a narrow range of habitat requirements and responds quickly to changes in habitat and water quality. Trautman (1981) indicated that since 1938 it has decreased in numbers, and even been extirpated from some areas in Ohio due to increased turbidity and siltation. In Illinois, the fish is disappearing from streams modified by impoundments and excessive siltation (Smith 1979). Clay (1975) also remarked on its absence from impounded waters in Kentucky. Similar reactions have also been noted in Minnesota (Eddy and Underhill 1974).

Ambient water temperature could also be a limiting factor as the species appears to favour cooler waters of glacial lakes and the headwaters of tributary streams, however no information exists on the temperature requirements of the species. Smith (1979) thought it to be intolerant of high summer water temperatures.

## Special Significance of the Species

The Rosyface Shiner, like other small cyprinids, may be an important forage and bait species where abundant. Scott and Crossman (1973) indicated its potential in studies of water quality because of its sensitivity to turbidity and siltation. Cherry et al. (1977) did utilize the species in a study to determine avoidance reactions of fish to free residual chlorine.

The disjunct distribution and habitat requirements are of interest to science in relation to the zoogeographical history and distribution of species subsequent to the Wisconsin glaciation.

## Evaluation

The Rosyface Shiner has a relatively wide distribution in Canada from southwestern Quebec to south central Manitoba. There is no indication that the species is in decline in Quebec and it is probably secure in that province at present, at least in streams tributary to the Ottawa River which have undergone little or no disturbance since the last surveys undertaken in early 1970s.

There is no evidence that Ontario populations are in decline, although those of southwestern Ontario should be surveyed on a regular basis. Scott and Crossman (1973) felt that it may be less common in some parts of the range than it was two or three decades ago, but had no evidence to support the supposition. Streams in southwestern Ontario are subject to a variety of human disturbances which could affect critical habitat resulting in demise of the resident stocks.

The species was brought to the attention of COSEWIC for consideration because of its apparent rarity in Manitoba, where it was supposedly known from only one location in the province, the Whitemouth River. Its presence in Manitoba is undoubtedly of long standing, and it has likely previously escaped detection for a variety of reasons. The species may be of particular concern in Manitoba because of its restricted distribution and dependanceon clear, fast moving waters which are being threatened by agricultural activity (Stewart, personal communication).

There appears to be no reason why the Rosyface Shiner should be considered to be of special concern in Ontario or Quebec, but should be considered as vulnerable in Manitoba.

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# The Status of the Warmouth, *Chaenobryttus gulosus*, in Canada*†

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The Warmouth, *Chaenobryttus gulosus*, is a recent addition to the southern Ontario freshwater fauna where it has been known since only 1966. Little is known of this species in its limited Canadian range where it is undoubtedly a pioneering species which may have gone undetected for several years prior to 1966. A breeding population is present at Point Pelee.

Le crapet à bouche guerrière est une espèce nouvelle à la faune des eaux douces du sud de l'Ontario, où elle est une migrante récente. On la connaît ici depuis 1966, mais on connaît très peu sur cette espèce au Canada. Sans doute, elle est une espèce colonisatrice, et elle y existait probablement quelques années avant de sa découvert en 1966. Une population reproductive est présente à la Pointe Pelée.

Key Words: Warmouth, *Chaenobryttus gulosus*, crapet à bouche guerrière, Centrarchidae, Ontario, status.

The Warmouth, *Chaenobryttus gulosus* (Cuvier, 1829) [see Wainwright and Lauder 1992] has been reported from Canada (Crossman and Simpson 1984) where it is known from only two locations in southwestern Ontario. Although most likely a recent natural migrant, it might have been present and undetected for several years before the initial discovery in 1966. A successful breeding population is present at Point Pelee (Crossman and Simpson 1984).

The Warmouth (Figure 1) is a small, robust centrarchid (sunfish), seldom exceeding 310 mm in length or 234 mg in weight. The species superficially resembles the Rock Bass, *Amblopites rupestris* and could be mistaken for it and, to a lesser extent, the Green Sunfish, *Lepomis cyanellus*, another small centrarchid which may be found in similar locations. The Warmouth has fewer anal spines than the Rock Bass (three versus six). The presence of many teeth on the tongue and the strong dark lines radiating out from the eye distinquish the Warmouth from the Green Sunfish.

In *Chaenobryttus gulosus* there are no black spots at the bases of the dorsal rays. There are, however, pale spots near the base of most soft rays of the dorsal and anal fins. In contrast, adults of *Lepomis cyanellus* have one large black spot at the base of each of the posterior soft dorsal and anal rays, and the head is less densely pigmented. In the Warmouth the maxillary reaches to, or beyond, the pupil so the mouth is larger than that in the Pumpkinseed and Bluegill.

The body of the Warmouth is ovoid, compressed, and somewhat broader than most sunfishes. The mouth is large and oblique with a projecting lower jaw. The pectoral fin is rounded and the caudal slightly forked. The colour of these fish varies from olive-yellow to brassy or muddy brown dorsally, shading to yellow or white below, a small red or orange spot may appear at the base of the vermiculated soft dorsal in breeding males. There are numerous darker markings on the sides which may be suggestive of vertical bands. The five or so dark lines radiating from the snout and eye across the cheeks and opercle help to distinguish this species (Clay 1962; Smith 1979).

Young Warmouth have heavy stippling on the head, and six or seven dark bands that extend from the mid-dorsal line to the ventral surface (Smith 1979; Crossman and Simpson 1984). The young of many other centrarchids have dark vertical bands on the sides so the separation of young Warmouth requires very careful examination.

## Distribution

The species is widely distributed in ponds, lakes and, occasionally, streams throughout the eastern United States (Cooper 1983). The northern limit appears to be along a line from southeastern Minnesota, central Wisconsin to Maryland (see Lee 1980: Figure 1), including western Pennsylvania only. The range extends south to Florida and the Gulf coast to Texas and the Rio Grande and west to

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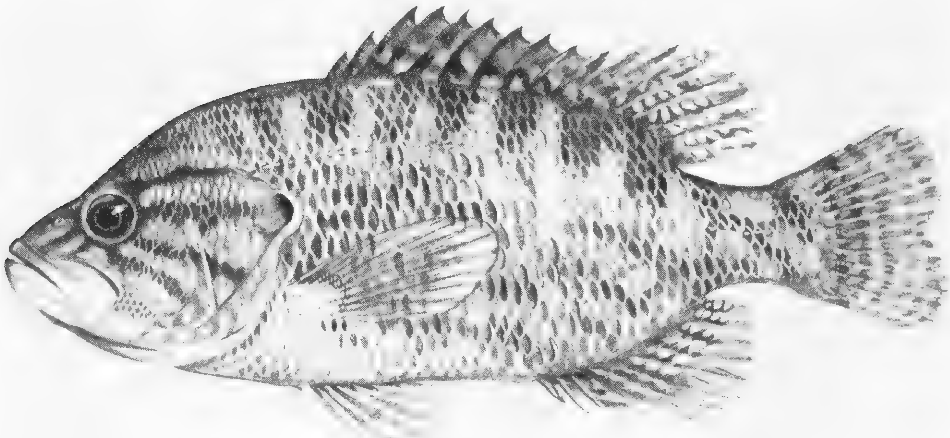

FIGURE 1. Warmouth, *Chaenobryttus gulosus*. (Illustration by Duane Raver, U.S. Fish and Wildlife Service, courtesy Don E. McAllister, Canadian Museum of Nature, Ottawa, Ontario)

New Mexico and Kansas. Successful transplants have been made west of the Rockies and in locations on the Atlantic slope (Lee *in* Lee et al. 1980). It has been introduced elsewhere in the U.S. (*see* McMahon et al. 1984). The closest populations had been one in the upper Huron River in Michigan, and several in the mid and lower reaches of Lake Erie tributaries in eastern Ohio from the Grand River to the Cuyahoga River and possibly one in a tributary (Toussaint River?) east of Toledo (Trautman 1981).

In Canada, the species has been recorded only from southwestern Ontario (Figure 2) where its presence was first discovered in 1966 (Crossman and Simpson 1984). *Chaenobryttus gulosus* has been taken from Lake Erie near Rondeau Provincial Park, about 35 km southeast of Chatham, Ontario (Table 1) and in two ponds at Point Pelee National Park 60 km further west of Rondeau.

## Protection

The species is widespread and common in the U.S. and is not listed as of any concern in any part of its range there (Williams et al. 1989).

Although given no specific protection in Canada, general protection is available, if required, through laws which protect the habitat of the species which include: the Ontario Lakes and Streams Improvement Act which prohibits the impoundment or diversion of watercourses which leads to siltation; the voluntary Land Stewardship II program of the Ontario Ministry of Agriculture and Food which is designed to reduce the erosion of agricultural lands and thus reduce siltation of habitat. The Point Pelee collection sites (see Table 1) are protected within the confines of the Point Pelee National Park. Similarly, one of the two Rondeau sites is within Rondeau Provincial Park.

This is a naturalized species in Canada [according to the recent definition of the American Fisheries Society (Kohler and Courtenay (1986)]. As a result of the growing concern for the potential negative impact of introduced species on native species, and on biodiversity (*see* Billington and Hebert 1991), some would argue that this species warrants no protection in Canada.

## Habitat

Extensive information on various habitat requirements for this species was provided by McMahon et al. (1984). The recorded captures of the Warmouth in Ontario have been from ecological conditions similar to those for other sunfishes (*see* Scott and Crossman 1973). Other warm water species such as Yellow Perch, *Perca flavescens*; Bowfin, *Amia calva*, and Brown Bullhead, *Ameiurus nebulosus*, were taken at the same sites (Crossman and Simpson 1984). Similar assemblages have been noted in the United States (Lewis and English 1949; Larimore 1957; Germann et al. 1974; Guillory 1979).

Typically, the Warmouth occurs in the deeper, open water of swamps, sluggish (low gradient) streams, ponds, or lakes with mud, silt or organic detritus substrates (Guillory 1979; Smith 1979; Cooper 1983). In Ohio, this species was said to occur (Trautman 1981) in silt-free water with an abundance of vegetation and a mucky bottom. In Kentucky they are usually found in clear areas with rooted aquatic vegetation (Clay 1962), and in Illinois streams, are associated with pool areas with beds of vegetation or roots and deadheads (Smith 1979). In Missouri,

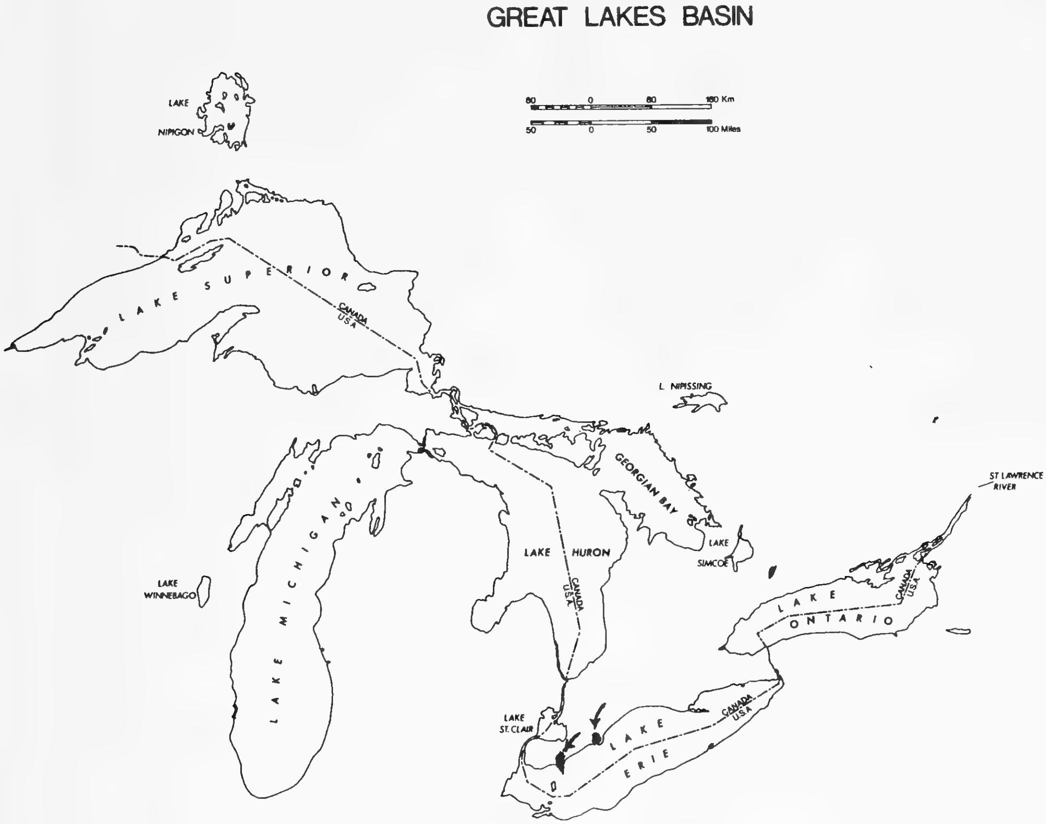


FIGURE 2. Canadian (southern Ontario) distribution of the Warmouth, *Chaenobryttus gulosus*.

Pflieger (1971) indicates that the species may occasionally be found in turbid waters, but prefers clearer waters. Cooper (1983) suggests they may tolerate brackish water to some degree. Trautman (1981) indicated that (in Ohio) the Warmouth preferred lakes, ponds, marshes and streams of low gradient with an abundance of aquatic vegetation and a mucky bottom covered with organic debris.

Undoubtedly, this is a warm water species, but there is no information on temperature tolerances. This could be a factor in limiting distribution even though habitat otherwise suitable should be abundant throughout much of southern Ontario. In Ontario, the species was captured at depths of 20 to 95 cm (ROM collection records), similar to those reported in the U.S. (Guillory 1979).

## Population Sizes and Trends

Eight specimens were taken from Rondeau Park sites (Table 1) between 1966 and 1968. Although no further specimens have been collected at Rondeau, 53 specimens have been taken (all but nine were released alive) at Point Pelee (Table 1) between 1983 and 1989 (Crossman and Simpson 1984). Of these, 28 were adults and 18 young-of-the-year (Crossman and Simpson 1984) indicating a breeding population.

Fisheries agencies along the Ontario side of Lakes Erie, St. Clair, and the Detroit and St. Clair rivers have been advised to be on the lookout for the species but, to 1992, no additional specimens had been noted. This is not surprising since no directed surveys for the species have been undertaken and it can be a difficult species to sample. Contact with personnel at Rondeau and Point Pelee parks in 1992 indicated that no recent records for the species had been noted. However, no assessment work that might have indicated presence or absence was carried out in 1991.

The two individual populations of *Chaenobryttus gulosus* in Ontario would appear to comprise one or more pioneering colonies resulting from recent natural dispersion, probably moving along the shore from Ohio to Lakes Erie and St. Clair rather than across the lake from Ohio (Crossman and Simpson 1984). Although first recorded in Canada in 1966 they probably arrived several years prior to that date. Pioneer populations often go undetected for some time prior to documentation (Crossman and

TABLE 1. Collection Records of *Chaenobryttus gulosus* in Canada.

| Location | Date | Number of Specimens | Source |
|---|---|---|---|
| Kent Co., Rondeau Provincial Park, Lake Erie, 42°17'N, 81°51'W | 5 June 1966 | 1 | RPM[a] F103-66 |
| Kent Co., Rondeau Provincial Park, Lake Erie, 42°17'N, 81°51'W | 1967 | 2 | Crossman and Simpson (1984) |
| Kent Co., Rondeau Provincial Park, Lake Erie, 42°17'N, 81°51'W | 1968 | 3 | Crossman and Simpson (1984) |
| Kent Co., Rondeau Provincial Park, Lake Erie, 42°17'N, 81°51'W | June 1968 | 1 | NMC[b] 88-0030 Possibly one of the above specimens |
| Kent Co., McLean Farm, outside Rondeau Provincial Park, Lake Erie, 42°19'N, 81°51'W | 8 August 1968 | 1 | ROM[c] 34267 Possibly one of the above specimens |
| Essex Co., Point Pelee National Park, Lake Pond, 41°57'44"N, 82°30'21"W | 31 March 1983 | 1 | ROM 42752 |
| Essex Co., Point Pelee National Park, Redhead Pond, 41°57'N, 82°30'W | 3 June - 18 October 1983 | 46 | Crossman and Simpson (1984) |
| Essex Co., Point Pelee National Park, Redhead Pond, 41°57'N, 82°30'W | 3 June 1983 | 2 | ROM 43022 Possibly part of the above specimens |
| Essex Co., Point Pelee National Park, Lake Pond, 41°58'00"N, 82°30'20"W | 11 August 1989 | 1 | ROM 56953 |
| Essex Co., Point Pelee National Park, near SE corner of Redhead Pond, 41°57'06"N, 82°30'20"W | 11 August 1989 | 4 | ROM 57157 |
| Essex Co., Point Pelee National Park, NE corner of Redhead Pond 41°57'24"N, 82°30'20"W | 11 August 1989 | 1 | ROM 57164 |

[a]Rondeau Park Museum
[b]National Museums of Canada – Canada Museum of Nature
[c]Royal Ontario Museum

Simpson 1984). In this case, they are a difficult species to sample and can be confused with the Rock Bass and Green Sunfish which are also known from the area.

If we consider native species as those which arrived here between the time aquatic habitats became available with the gradual "retreat", or fluctuations of the Wisconsinan ice, and the arrival of European settlers, this is not a native (indigenous) species. If the established population in Point Pelee National Park survives, the Warmouth would have to be considered a naturalized species in Ontario. The range may still be expanding (Mandrak 1989) where conditions are suitable and one might expect to find it at other sites along the shores of Lakes Erie and St. Clair, as suggested by Crossman and Simpson (1984).

## Biology

Nothing is known of the biology of the Warmouth in Canada but, in general, its life history may be similar to that of the Green Sunfish (Smith 1979) and the Rock Bass (see Scott and Crossman 1973 for details). Information on age, growth and food for U.S. populations were provided by McMahon et al. (1984). Detailed life histories on the Warmouth have been reported from studies in Iowa (Lewis and English 1949), Illinois (Larimore 1957) and Georgia (Germann et al. 1974). Other studies related to growth, length-weight relationships and population structure have been summarized by Carlander (1977), Panek and Cofield (1978), and (Guillory 1980) among others.

Spawning occurs in spring and early summer over rubble or loose vegetation or debris. Spawning behaviour is that typical of sunfishes (Cooper 1983). The spawning season in Florida is protracted, and females spawn several times in one season (Guillory 1980). In Ontario the length of season may limit this.
Fecundity estimates range from 800 to 34 000 eggs per female, larger females producing more eggs. Maturity seems to be related more to size than age; depending on growth rate, Warmouth may spawn at age I or II. Size at maturity varies with latitude and food availability, ranging from 51 mm in Illinois to 102 mm in Georgia (Larimore 1957; Germann et al. 1974; Guillory 1980). As a result, one would expect individuals in Ontario to mature at lengths of 50 mm or less.

The species has hybridized successfully elsewhere with many other sunfishes, including Rock Bass (Schwartz 1972, 1981; Smith 1979; Parker et al. 1985). Growth depends on habitat conditions (Panek and Cofield 1978; Guillory 1980). Individuals in

some populations have been noted to grow to 152 mm in 13 months and in others only to 137 mm in six years (Cooper 1983). Several authors (e.g., Panek and Cofield 1978; Guillory 1980) have developed length-weight relationships and condition factors for the species.

Individuals live at least eight or nine years and seldom exceed 310 mm in length or 340 mg in weight, although a O.9 kg individual was reported by the U.S. Fish and Wildlife Service (Don E. McAllister, Canadian Museum of Nature, Ottawa, Ontario; personal communication).

The Warmouth is probably more piscivorous than other sunfishes; small fishes, crayfish and aquatic insects comprise the bulk of their diet (Smith 1979; Cooper 1983). Smaller individuals feed on zooplankton, midges and caddisfly larvae with a shift to fish and crayfish as the fish become larger (Guillory 1980; Cooper 1983).

Little is known of parasites and diseases. Benz and Pohley (1980) have recorded the presence of the nematode *Philometra* sp. from the occulo-orbit of centrarchids from Georgia, including *Chaenobryttus gulosus*.

## Limiting Factors

Basically the Warmouth is a warm-water species and its range extension may be limited by seasonal water temperature. Further study is required, but under present conditions, the species probably would not be found much further north in Canada than at the present latitude (see Mandrak 1989 for potential range expansion under climate warming).

Except when spawning, the Warmouth is solitary, not forming schools (Cross 1967), and does not dominate or eradicate other populations of syntopic centrarchids such as the Green Sunfish or Bluegill, *Lepomis macrochirus* (Smith 1979). Guillory (1980) found it was usually one of the least abundant of the centrarchids. Availability of suitable forage species and predation by larger fishes such as the Largemouth Bass, *Micropterus salmoides*, occupying the same habitat would limit populations.

Smith (1979) indicated that siltation, drainage of natural marshes and lakes, and other disruptions leading to destruction of aquatic vegetation has led to a decline of the species in Illinois. The nematode *Philometra* sp., if present in Canada, would not be limiting.

## Special Significance of the Species

The species is too rare in Canada to be of importance either economically or as a forage species. However, its presence here is of zoogeographic interest as it presents another example of the recent northward dispersal of freshwater fishes.

Although small and solitary in nature, in the United States the Warmouth is common throughout most of its range and is popular in some areas as a sport fish (Clay 1962), but less so than the Bluegill or crappies. It is a naturalized species with the potential of adversely impacting native species and biodiversity.

## Evaluation

If the populations in Ontario survive, the species would have to be considered a naturalized part of the aquatic fauna of Ontario. Although the population in Point Pelee National Park is probably secure, the species should be considered rare in Canada where it is at the northeastern fringe of its range. Populations in Ohio are close to those of Point Pelee and the general distribution in that State have remained relativley unchanged in the latter half of this century, but the species is uncommon where found (Trautman 1981).

Until the nature of the impact of this species is determined, these populations enjoy the protection of being within Federal or Provincial Parks, are subject to few threats and are vulnerable only to natural factors.

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# The Status of the Bearded Seal, *Erignathus barbatus*, in Canada*

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Bearded Seals, *Erignathus barbatus*, reside year-round in Canadian arctic and sub-arctic waters. They are patchily distributed at relatively low densities throughout their range, typically inhabiting areas of broken ice and open water with depths of less than 200 m. Estimates of population size are not available, although summing different indices obtained over the past 35 years for several different regions suggest that a minimum of 190 000 Bearded Seals may inhabit Canadian waters. Hunt statistics collected between the late 1950s and mid-1980s for 46 arctic communities indicated an annual harvest of approximately 3000 to 5000 animals. Current rates of harvest are available only for a few arctic communities, but hunters appear to be taking fewer seals now than they did several decades ago. Information on current sightings and catch-per-unit-effort obtained from hunters across the Arctic suggest that Bearded Seal stocks are stable in Canada. The collection of harvest information should be resumed and continued on a routine basis in all northern communities. Better estimates of age-specific rates of natural mortality and pregnancy are also needed, as well as current population size and growth rates.

Les phoques barbus, *Erignathus barbatus*, vivent pendant toute l'année dans les eaux arctiques du Canada. Ils sont répartis par petits groupes épars dans toute leur aire, en général, sur des banquises disloquées et dans les eaux libres de glace à des profondeurs de moins de 200 m. On ne dispose pas à l'heure actuelle d'estimations précises de la taille de la population et du taux de capture dans les eaux canadiennes. Toutefois, des données de relevés et des statistiques de chasse recueillies entre la fin des années 1950 et le début des années 1980 ont indiqué que le troupeau comptait au moins 190 000 bêtes et que les captures annuelles atteignaient environ 3 000 à 5 000 phoques. D'après des observations sur le terrain des phoques barbus et des informations sur les captures par unité d'effort fournies par les utilisateurs de la ressource, les phoques barbus ne seraient pas en danger au Canada. La population canadienne n'est pas en danger immédiat; pourtant, il faudrait reprendre la collecte de statistiques sur les captures. Il faut aussi de meilleures estimations du taux de mortalité par âge et du taux de grossesse pour l'Arctique canadien, ainsi que du taux de croissance actuel des populations et de leur taille.

Key Words: *Erignathus barbatus*, Bearded Seal, phoque barbue, arctic marine mammals., Phocidae, pinnipeds, seals, status.

Bearded Seals, *Erignathus barbatus* Erxleben 1777, are large phocids that inhabit arctic and sub-arctic waters. Adults (Figure 1) are typically grey in colour and unpatterned, although some animals have a brownish or reddish colouration, especially on the face and foreflippers. The external characteristics that distinguish this species from other northern phocids are square-shaped foreflippers, a disproportionately small head, numerous long mystacial vibrissae, and four teats. Adults average 2.1 to 2.4 m in length and attain maximum weights of 350 to 360 kg (Chapskii 1938; McLaren 1958a; Johnson et al. 1966; Burns 1967, 1981; Benjaminsen 1973). Some studies have reported that females are slightly longer than males (McLaren 1958a; Johnson et al. 1966; Burns 1967; Benjaminsen 1973), but there is no evidence to verify that these differences are statistically significant.

## Distribution

The distribution of Bearded Seals is circumpolar and boreoarctic and extends as far south as the southern end of the Okhotsk Sea (44°N) in the Pacific Ocean and northeastern Newfoundland (50°N) in the Northwest Atlantic Ocean (Allen 1880; Ognev 1935; King 1983). A few extralimital occurrences, of juveniles mostly, have been reported in the waters off Spain and Portugal, 40 to 44°N (Ray et al. 1982). In North American waters, strays have been found as far south as Cape Cod (Mansfield 1967) and recently a yearling male was found in poor condition on the southern shore of the St. Lawrence Estuary (Gosselin and Boily 1994).

Within Canada, Bearded Seals reside year-round in arctic waters as well as in Hudson Bay, Hudson Strait, Labrador Sea and probably in James Bay (Mansfield 1967; Mansfield et al. 1975; Smith and Taylor 1977; Boles et al. 1980; Ray et al. 1982) (Figure 2). A small resident population in the waters off southern Labrador and southern and eastern Newfoundland may have been recently extirpated (Ray et al. 1982).

Two subspecies have been suggested: *Erignathus barbatus barbatus* is distributed from the central

* Reviewed and approved by COSEWIC 14 April, 1994, report accepted no status designation required.

Canadian Arctic east to the Laptev Sea (north of Siberia) and *Erignathus barbatus nauticus* is distributed from the central Canadian Arctic west to the Laptev Sea (Manning 1974). The exact boundary between the two subspecies is not clearly defined. There is disagreement on whether the differences in body size and growth rates of cranial bones between specimens taken from the two regions are sufficient to warrant subspecies distinction (Kosygin and Potelov 1971; Manning 1974; Smith 1981).

## Protection

*International*

This species has not been assigned a designation under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

*National*

*Canada*

The Marine Mammal Regulations of the Fisheries Act of Canada (Canada Department of Fisheries and Oceans 1993) provides for the management and control of the harvest of Bearded Seals in Canadian waters. The regulations permit residents to kill seals for food purposes. Native hunters may also take seals for social or ceremonial purposes. There are no restrictions on the sale or trade of pelts resulting from the harvest, although a marine mammal transportation licence (export permit) is required to transport marine mammal material out of the Northwest Territories. No sport hunting of Bearded Seals is permitted.

Over the past decade, two coastal land claim agreements have come into effect: the Inuvialuit Final Agreement, which covers the Yukon North Slope and the northwestern portion of the Northwest Territories and the Nunavut Land Claim Agreement, which covers the central and eastern portions of the Northwest Territories. In 1976, the James Bay and Northern Quebec Agreement was signed. It covers the territory within western and northern Quebec, including marine mammals that occur there in estuary areas. The Makivik Offshore Claim, which is currently under negotiation, will cover the coastal areas around western and northern Quebec. Under the terms of the three signed agreements, the responsibility for managing arctic marine mammal populations in Canadian waters, except off Labrador, lies with public wildlife management boards. Land claim beneficiaries and representatives from the federal, territorial and/or provincial governments sit on these boards. The Minister of Fisheries and Oceans is obliged to implement management decisions made by the public wildlife management boards except those that conflict with "disallowance provisions" (e.g., decisions that would conflict with the principles of conservation) in the agreement.

*United States*

The United States Marine Mammal Protection Act of 1972 permits coastal Alaskan natives to harvest Bearded Seals for food or the production of culturally authentic handicrafts and clothing. Commercial harvesting is prohibited.

## Population Size and Trend

No recent population estimates are available for the entire Canadian Arctic, however earlier estimates are available for some areas. In 1958, McLaren (1958b) estimated that the waters of Foxe Basin, Hudson Bay, Hudson Strait/Ungava Bay, and off eastern and northern Baffin Island contained 186 000 Bearded Seals. This crude estimate was based on catch statistics (excluding animals struck and lost), the relative proportion of Bearded Seals to Ringed Seals, *Phoca hispida,* sighted during shipboard surveys, and the amount of suitable habitat within 16 km of shore and water depths of less than 200 m. In the past twenty years, population indices for Bearded Seals have been reported for parts of the Western Arctic and High Arctic based on aerial surveys. These population estimates have not been corrected to include animals that were below the surface of the water at the time of the survey because no correction factors exist. Indices for the eastern Beaufort Sea in 1974 to 1979 range between 1200 and 3100 animals (Stirling et al. 1977, 1982; Kingsley and Lunn 1983). Aerial surveys flown in the High Arctic between the mid-1970s and early 1980s revealed low numbers of Bearded Seals (maximum densities: 0.05 to 0.24 seal/sq km) in areas of preferred habitat (Finley 1976; Koski and Davis 1979; Koski 1980a,b; Koski and Davis 1980; Kingsley et al. 1985); no population estimates were calculated for these surveys. Surveys conducted in the offshore waters of western Baffin Bay and eastern Lancaster Sound in late June-early July 1979 produced uncorrected estimates of 7400 to 9500 seals (Koski and Davis 1980).

Few reliable harvest statistics are available for Bearded Seals because they are taken for domestic purposes, and in relatively small numbers. However, some harvest records were kept for 46 communities between the late 1950s and mid-1980s (Beaubier et al. 1970; Smith and Taylor 1977; Native Harvesting Research Committee 1976, 1979, 1982a,b; Smith 1981; Donaldson 1988; Pattimore 1985, 1986; Gamble 1984, 1987a,b). Roughly 2400 Bearded Seals were reported taken on an annual basis in the Canadian Arctic, excluding animals that were struck-and-lost. Losses due to sinking have not been adequately quantified, however in open-water hunts it is common for more than 50% of the animals struck to sink before they can be retrieved (Burns 1967). During the spring hunt, when seals are usually shot while they are hauled out on the ice to bask, struck-and-loss rates drop to approximately 25% (Burns and

FIGURE 1. Bearded Seal hauled out on ice (courtesy Wayne Lynch©).

Frost 1979). Adjusting the reported take to account for sinking losses yields a total annual kill that was probably closer to 3000 to 5000 during that period.

Although only sparse harvest data exist, the numbers of Bearded Seals taken seem to have declined in recent years. For example, between 1962 and 1980, an average of 66 Bearded Seals were reported harvested on an annual basis in the Western Arctic (50 from Sachs Harbour, n = seven years; 16 from Holman, n = one year) (Smith and Taylor 1977; Smith 1981), whereas between 1987 and 1993, an average of 22 seals were reported taken annually by five Western Arctic communities (nine from Sachs Harbour, n = seven yrs; eight from Holman, n = seven years) (Fabijan, 1991a,b,c, 1995a,b,c). In Grise Fiord during 12 years between 1962 to 1984, an average of 25 Bearded Seals were reported harvested each year (Smith and Taylor 1977; Pattimore 1986; Stewart et al. 1986; Donaldson 1988) compared with a reported annual average catch of 13 seals from 1992 to 1993 (C. Craig, Department of Fisheries and Oceans, Winnipeg, Manitoba; personal communication). In Lake Harbour during nine years between 1962 and 1984, an average of 111 seals were reported harvested each year (Smith and Taylor 1977; Pattimore 1986; Stewart et al. 1986; Donaldson 1988) compared with an annual average of 67 seals in 1992 to 1993 (Craig, personal communication).

Changes in data collection techniques and environmental conditions over the past 20–30 years may account for some differences in reported harvests. The recent data were collected in each community by personal interviews, while older data were often collected by community officials (e.g., Royal Canadian Mounted Police officers) and from fur records. The trend toward declining harvests probably also reflects an overall shift away from the traditional Inuit lifestyle (e.g., reduced hunting effort, increased use of southern foods and equipment, use of snowmachines instead of dog teams). A few communities have maintained a more traditional way of life and their take of Bearded Seals has probably remained relatively constant or possibly increased slightly. For example, Igloolik hunters still harvest numbers of Bearded Seals for food and making rope and kamiks (B. Parker, Department of Renewable Resources, Government of Northwest Territories, Igloolik, NWT; personal communication). It is unlikely that the current harvest of Bearded Seals in the Canadian Arctic exceeds 4000 animals per year.

Current estimates of maximum sustainable yield (MSY) are not available for the Canadian Arctic but two older estimates have been published. Based on data from the eastern Canadian Arctic, McLaren (1958b) suggested an MSY of "about 5% of the mid-year population" as being "wholly safe" and, based

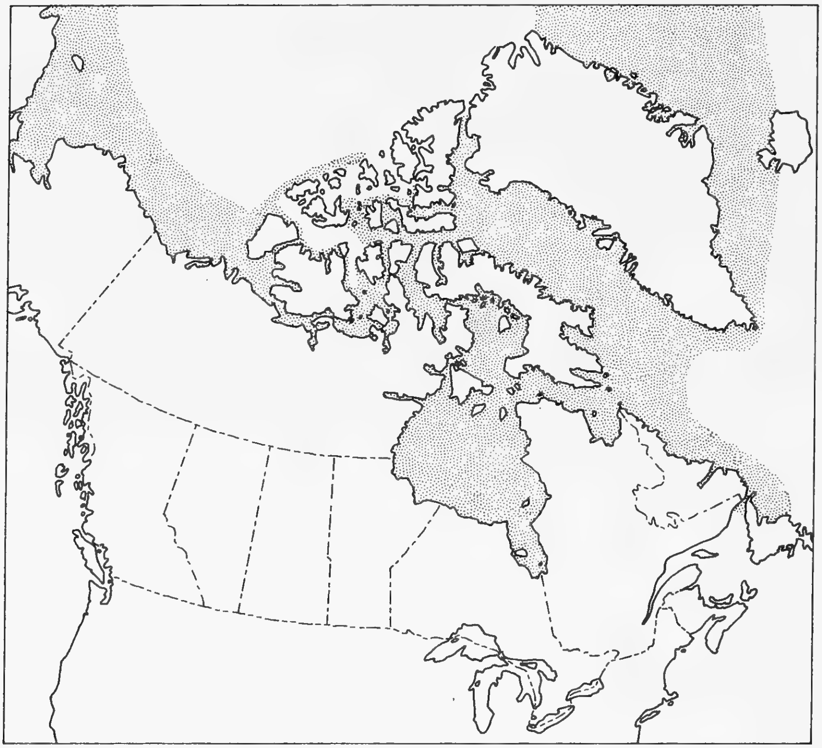

FIGURE 2. Distribution of Bearded Seals in Canadian waters.

on kill data collected from the Sea of Okhotsk, Fedoseev (1973) also reported an MSY of 5%. An examination of the Western Arctic data, for which conservative population indices and current kill data are available, shows that the current rate of exploitation probably removes no more than 3.3% of the population each year.

While this calculation relies on a number of assumptions and historic data for one small region of the Canadian Arctic, it suggests that the Bearded Seal populations that inhabit Canadian waters may be relatively stable. This perspective is supported by hunters who have not reported declines in sightings or catch-per-unit-effort (C. Furgal, Department of Environmental Studies, University of Waterloo, Waterloo, Ontario; L. Harwood, Department of Fisheries and Oceans, Iqualuit, Northwest Territories; Parker; K. Seto, Department of Fisheries and Oceans, Iqaluit, NWT; personal communications).

## Habitat

Bearded Seals prefer areas of moving ice and open water in depths of less than 150 to 200 m, and tend to avoid areas of thick shorefast ice (McLaren 1958b; Burns 1967; Mansfield 1967; Davis et al. 1975; Burns and Frost 1979; Stirling et al. 1982; Kingsley et al. 1985; Cleator and Stirling 1990). In a few areas, Bearded Seals maintain breathing holes in landfast ice throughout the winter (Mansfield 1967; Stirling and Smith 1977). This is probably because the ice in those areas freezes late and breaks up early (Stirling et al. 1983), and also because benthic production there may be high (Smith 1981). Bearded Seals have been observed in waters deeper than 500 m during March and April (Finley and Renaud 1980). They regularly use pack ice for resting, pupping and moulting (Fay 1974).

## General Biology

*Reproductive Capability*

Most males reach sexual maturity at 6 or 7 years of age (McLaren 1958a; Tikhomirov 1966; Burns 1967; Burns and Frost 1979; Smith 1981). In Canadian arctic waters, most breeding likely occurs between mid-April and late May, although males are in breeding condition from about mid-March to late June (McLaren 1958a). The mating system of the Bearded Seal is unknown although they are probably polygnyous (Budelsky 1992).

Females may begin to ovulate at three to four years of age and most are pregnant for the first time at five or six years of age (McLaren 1958a;

Tikhomirov 1966; Burns 1967; Potelov 1975; Burns and Frost 1979; Burns 1981; Smith 1981). Reported estimates of the ovulation rate range between 0.46 and 1.00 (Stirling et al. 1977; Smith 1981) while pregnancy rates range between 0.33 and 0.85 (Burns 1967; Stirling et al. 1977; Burns and Frost 1979; Smith 1981). Typical pregnancy rates in adult females (six years and older) are 0.80 to 0.85. Most sexually mature females probably reproduce annually (Tikhomirov 1966; Burns 1967; Fedoseev 1973; Burns and Frost 1979; Smith 1981); however, fertility rates may decline when resources become limited in an area (Burns 1981; Smith 1981). No evidence of reproductive senility has been reported.

Females with pups usually ovulate and mate after their pups are fully weaned (Burns and Frost 1979). Implantation is delayed and occurs between mid-July and early August, approximately two months after breeding (Chapskii 1938; Burns and Frost 1979; Smith 1981). The single neonates are first observed between mid-April and early May (Chapskii 1938; McLaren 1958a; Johnson et al. 1966; Potelov 1975; Burns 1981). Lactation is estimated to last only 12 to 18 days (Burns 1967).

At birth, the sex ratio is close to unity, while in older age classes females are often more numerous (Sleptsov 1943; Fedoseev 1973; Burns and Frost 1979; Smith 1981). Age-specific mortality rates have been calculated from life tables based on fitted age distributions derived from Bering-Chukchi seas harvest data (Burns and Frost 1979). The higher mortality rates reported for males may account for why adult females are slightly more numerous than adult males (Burns and Frost 1979). However, the preponderance of females in the catch statistics may reflect the increased vulnerability of females at specific times of year or differential segregation of the sexes (Smith 1981). Harvest data suggests that the maximum life span in the wild ranges between 23 and 31 years of age (Benjaminsen 1973; Burns and Frost 1979; Smith 1981).

*Species Movement*

In the Bering and Chukchi seas, many Bearded Seals make well-defined seasonal movements in order to maintain contact with ice year-round (Johnson et al. 1966; Burns 1967). Aerial survey data suggest that Bearded Seals in Baffin Bay may also move between coastal and offshore areas to stay with the ice (Koski 1980a). Over much of their range, however, Bearded Seals appear to be relatively sedentary, undertaking more local movements in response to ice conditions (Vibe 1950; McLaren 1962; Fedoseev 1973). Throughout their range, Bearded Seals appear to be patchily distributed at relatively low densities (Burns 1967; Burns and Frost 1979; Stirling et al. 1982), although during the winter months prior to break-up and during early summer when the availability of ice pans for haulout are limited, they are likely more aggregated than at other times of the year.

*Behaviour/Adaptability*

Bearded Seals typically occur alone or in small groups. Even when several individuals are hauled out on a single large floe, they position themselves evenly around the perimeter of the pan, facing in different directions (Burns 1981). Their response to human disturbance is varied. While hauled out on the ice during warm calm days in late spring and summer, they are relatively undisturbed by the close presence of men, boats or low-flying aircraft. During winter, however, human activity on the ice will cause a basking seal to quickly enter the water or a swimming seal to surface several hundred metres from the sound source (Burns 1981). The reasons for these differences in behaviour are unknown although in late spring and summer, hauled-out seals have more access to escape routes. Like basking Ringed Seals, Bearded Seals may also be more reluctant to enter the water once dry and warm.

Bearded Seals produce loud trill-like calls, that can last up to about 30 seconds in duration and can be heard for distances of 25 km or more underwater, between March and June (Stirling et al. 1983; Cleator et al. 1989). Limited evidence suggests that only males call and that they may use these calls to advertise breeding condition, territoriality, or both (Dubrovskii 1937; Chapskii 1938; Ray et al. 1969; Burns 1981; Stirling et al. 1983; Cleator et al. 1989). Typically, calling seals are distributed in a random arrangement, one to three km apart, and remain fairly stationary; this species may use lek-display (Budelsky 1992). There is evidence of geographical variation in the call repertoire, that appears to be relatively stable from one year to the next and may be characteristic of discrete breeding stocks (Cleator et al. 1989).

Bearded Seals will consume a wide variety of food items including pelagic fishes (Burns and Frost 1979; Lowry et al. 1980; Finley and Evans 1983; Antonelis 1993); however, they are primarily benthic feeders and usually the bulk of their diet is made up of only a few species. Prey selection appears to be based on the availability of prey, therefore the diet may vary within a relatively small area and over a short period (Antonelis et al. 1993).

## Limiting Factors

*Predation*

Polar Bears (*Ursus maritimus*) are the chief predators of Bearded Seals. Limited data suggest that at least half of the Bearded Seals killed by bears are pups and subadults (Stirling and Archibald 1977). Occasionally, parts of young Bearded Seals have been found in the stomachs of walruses. Whether walruses actively prey on Bearded Seals or merely eat them as carrion has not yet been determined,

however indirect evidence of predation has been reported (Lowry and Fay 1984). Bearded Seals are often infested with large numbers of internal parasites (see review by Burns 1981); however, it is not known to what extent parasitism contributes to natural mortality. It is likely that Bearded Seal populations near communities will continue to be hunted and hence locally depressed in numbers. However, the importance of this species to Inuit has diminished in many communities in recent years and some populations may be located so far from communities that they are not subject to human hunting pressure. If this situation persists, it is unlikely hunting will be a significant limiting factor on Bearded Seal populations across the Canadian Arctic.

*Environmental Contamination and Human Disturbance*

DDT and related residues, PCBs, and heavy metals (i.e., mercury, selenium, nickel, copper, zinc, and cadmium) are present in the tissues of Bearded Seals (see reviews by Burns 1981 and Kelly 1988). Only a few studies have been conducted in Canadian waters to date. Analysis of samples collected from animals in eastern Amundsen Gulf and eastern Hudson Bay has shown that Bearded Seals accumulate large amounts of mercury and selenium in the liver and that there may be regional differences in the level of contamination (Smith and Armstrong 1975, 1978). Positive correlations have been detected between mercury level and age, as well as between selenium level and age (Freeman and Horne 1973; Smith and Armstrong 1975, 1978).

Concentration levels of PCB's and other organochlorine contaminants have been examined in small samples of Bearded Seals and Ringed Seals caught in the waters off northern Quebec and Baffin Island (Thomas 1990; Muir and Rosenberg 1990). In general, concentration levels of organochlorine contaminants in the blubber are considerably lower in Bearded Seals. This difference may reflect the lower trophic level at which Bearded Seals typically feed compared to Ringed Seals (i.e., benthic organisms versus fish). Little is known about the effects of pesticides and heavy metals on marine mammals, and it is not known if they contribute to mortality in this species.

Aside from local reductions in population numbers as a result of hunting, the most serious threat to this species is industrial activity. Bearded Seals may be vulnerable to even relatively minor environmental disturbances because they are distributed in small, localized populations. Dredging, dumping, and accidental spills that affect benthic productivity, for example, are a concern in areas where Bearded Seals occupy shallow waters (e.g., southeastern Beaufort Sea) and rely solely on benthic species for food (see review by Kelly 1988). In deeper areas (e.g., Lancaster Sound) where Bearded Seals feed on a wider variety of prey, including pelagic fish, they are probably at less risk.

Oil spills also pose a direct risk to the health of Bearded Seals that inhabit waters near a spill. Although direct exposure to oil has not been investigated in Bearded Seals, it would likely cause stress, eye irritations or damage, and accumulate in body tissues and fluids thereby causing tissue damage, as has been reported for other northern pinnipeds (Smith and Geraci 1975; Engelhardt et al. 1977; Geraci and Smith 1977). Mortality due to oiling is likely to be most significant in pups and older animals, and during the moult when seals are undergoing physiological stress (Smith and Geraci 1975; Davis and Anderson 1976; Geraci and Smith 1977). Bearded Seals may have enzymatic mechanisms for metabolizing and excreting components of crude oil similar to those found in Harp Seals (Lyle Lockhart, Department of Fisheries and Oceans, Winnipeg, Manitoba, unpublished data). The effects of chronic exposure to weathered oil are unknown.

Bearded Seals prefer areas of moving pack ice and open water, which also offer the best navigation routes for ships travelling through ice-choked arctic waters. High noise levels produced by vessels and other industrial activities can cause hearing damage in pinnipeds (see review by Myrberg 1990); however, the Bearded Seals' preference for pack ice with cracks and leads allows them to move away from most disturbance (Mansfield 1983). In spring, in areas where seal movement is restricted by ice and prolonged exposure to underwater noise from industrial operations (e.g., drill ships) could mask auditory communication, disruption of breeding activities and social organization may occur (Cleator and Smith 1994).

*Species Competition*

While there doesn't appear to be an immediate interaction between this species and any commercial fisheries, there is currently a commercial fishery for Pandalid shrimp in eastern Davis Strait and a number of exploratory fisheries for whelks (*Buccinum* sp.), shrimp (*Pandalus borealis* and *P. montagui*), and Iceland Scallops (*Chlamys islandica*) off the eastern coast of Baffin Island and in Ungava Bay and Hudson Strait (D. Chiperzak, Department of Fisheries and Oceans, Inuvik, NWT; personal communication). As Bearded Seals appear to vary their diet according to the availability of different prey species in an area, the introduction of a commercial fishery may have little effect on them as long as abundant alternate prey are available.

Bearded Seals appear to avoid areas heavily used by Walruses *(Odobenus rosmarus)*. Inter-specific competition for benthic prey or predation by walruses may explain the low numbers of Bearded Seals in areas frequented by Walruses (Cleator and Stirling 1990).

*Special Significance of the Species*

Historically, Bearded Seals were a valuable resource to the Inuit, who used their meat for food, their blubber for fuel, and their skin for dog-team traces, harpoon lines, footgear, and any other use that required strength and durability. However, with increased availability of substitutes in the past 20 years, its importance to many local economies has declined. Bearded Seals continue to be important prey for Polar Bears (Stirling and Archibald 1977), especially in areas of active ice (Smith 1980). Canada is under international obligation to protect the Polar Bear populations that reside within its boundaries so it is essential that Bearded Seal populations are also protected.

## Evaluation

There are no recent or accurate survey data available to determine current population levels in Canadian waters or to permit the evaluation of population trends. However in the Western Arctic, current harvest data and abundance indices collected twenty years ago, and the fact that hunters have not raised concerns there about declining numbers of Bearded Seals, suggest that the current populations in that region may be relatively stable. Hunters in other regions of the Canadian Arctic also have not reported a decline in sightings or in catch-per-unit-effort. In northern Foxe Basin, for example, hunters report that Bearded Seals are abundant and that they still take considerable numbers of them (Parker, personal communication). Anecdotal comments like these suggest that most, if not all, Canadian Bearded Seal populations may be relatively stable in spite of hunting pressure near communities. Nevertheless, given the patchy distribution and paucity of data on this species, each population should be treated as a discrete stock and managed on the basis of accurate and current estimates of population size and growth and data on rates of harvest and hunting loss. Only in this way, can we hope to ensure the long-term sustainability of this species in northern Canadian waters.

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# The Status of the Long-finned Pilot Whale, *Globicephala melas*, in Canada*

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The Long-finned Pilot Whale, *Globicephala melas*, is a mainly pelagic species widely distributed in the cold temperate waters of the North Atlantic and the Southern Hemisphere. It regularly migrates in summer to Canadian inshore waters following spawning squid. Drive fisheries from 1947 to 1971 seriously depleted numbers of *Globicephala melas* off Newfoundland. Mass strandings represent a major known source of natural mortality for this species. The effects of incidental entrapments, pollutants, and fisheries for prey species remain relatively unknown, but these factors have the potential for limiting this species. *Globicephala melas* has recently been used in satellite tracking and DNA fingerprinting studies, and is a common subject in the study of mass strandings. There are few reliable recent population estimates for *Globicephala melas*, but even optimistic recovery forecasts based on drive fisheries in Newfoundland would produce a present population substantially lower than pre-whaling numbers. Given that there are no immediate threats to the population a COSEWIC status designation would not seem to be warranted at this time.

Le globicéphale noir, *Globicephala melas*, est une espèce plutôt pélagique retrouvée un peu partout dans les eaux froides tempérées de l'Atlantique nord et de l'hémisphère austral. En été, il migre régulièrement vers les eaux côtières canadiennes à la recherche de calmars. La chasse par rabattage effectuée de 1947 à 1971 en a décimé les effectifs dans les eaux côtières de Terre-Neuve. Les echouages en masse sont une importante cause connue de mortalité, par contre, les incidences de captures accidentelles, les élements polluants et l'exploitation des espèce-proies demeurent relativement mal connues. Elles ont toutefois un potentiel comme facteurs limitatifs de l'espèce. *Globicephala melas* a été l'objet d'études de repérage par satellite et d'identification à l'ADN, ainsi que des échouages en masse. Aucune prévision démographique récente fiable n'est disponible en ce qui concerne *Globicephala melas*, mais même des prévisions optimistes quant au rétablissement des effectifs décimés par la chasse par rabbatage effectuée dans les eaux de Terre-Neuve ne donneraient qu'un effectif nettement inférieur à l'abondance pré-exploitation. Puisque elles ne font pas face à des menaces immédiates, une désignation de statut par le CSEMDC n'est pas justifiée à ce moment-ci.

Key Words: Long-finned Pilot Whale, globicéphale noir, *Globicephala melas* (= *Globicephala melaena*), toothed whales, Odontoceti, Cetacea, marine mammals, status.

The Long-finned Pilot Whale, *Globicephala melas* (Traill 1809), is variously known as the Northern Pilot Whale, Atlantic Pilot Whale, Pothead, Blackfish, Calling Whale, and Caa'ing Whale. It has often been cited as *Globicephala melaena*, although *Globicephala melas* is the more taxonomically correct form of the name (Rice 1989).

The species is characterized by a bulbous forehead, a falcate dorsal fin with a long base located far forward on the body, a slight beak, and sharply pointed pectoral flippers that may reach one-fifth of the body length (Figure 1). It is slate-grey to black in colour, although pale or albino individuals are sometimes observed (Sergeant and Fisher 1957; Hain and Leatherwood 1982; Bloch 1994). An anchor-shaped patch of greyish-white on the throat extends into a grey stripe along the underside which expands around the navel and surrounds the genital area (Sergeant and Fisher 1957). Other markings may include a variable grey saddle behind the dorsal fin and a grey or white streak behind the eye, both of which may be more common in Southern Hemisphere populations (Scott 1942; Sergeant and Fisher 1957; Davies 1960; Aloncle 1972; Aguayo 1975). Young animals are lighter in colour overall, and the saddle and eye blaze, if present, apparently become evident after three to five years of age (Starrett and Starrett 1955; Sergeant and Fisher 1957; Bloch et al. 1994).

*Globicephala melas* can be distinguished from the closely-related Short-finned Pilot Whale, *Globicephala macrorhynchus*, by differences in range, size, external markings, length of pectoral flippers, size of tail flukes, tooth count, and skull characteristics (Fraser 1950; Yonekura et al. 1980; Leatherwood and Reeves 1983; Bloch et al. 1994). Most differences are not entirely reliable, however, as there is some overlap in range and physical char-

*Reviewed and approved by COSEWIC 14 April 1994, report accepted; no status designation required.

acteristics (Leatherwood et al. 1976; Van Bree et al. 1978; Yonekura et al. 1980; Casinos 1981; Powers et al. 1982; Nores and Perez 1988; Bloch et al. 1994). The teeth may provide the best distingushing characteristic: those of *Globicephala macrorhynchus* are generally fewer (seven to nine instead of 10 to 12 in both jaws) and larger (Sergeant 1959).

*Globicephala melas* shows marked sexual dimorphism. Males can reach lengths of approximately 620 cm and weights of three tons, while females are approximately 18 to 25% smaller (Sergeant 1962; Martin et al. 1987; Kasuya et al. 1988b; Desportes 1990; Bloch 1994). Males also have longer flippers and longer and wider flukes than females, and more often have the eye-streak marking (Bloch et al. 1994).

## Distribution

*Globicephala melas* is widely distributed in cold temperate waters of the North Atlantic and southern oceans (Figure 2). The northern and southern forms, which are widely separated geographically and may vary in coloration, are sometimes regarded as subspecies: *Globicephala melas melas* in the north, and *Globicephala melas edwardi* in the south (Davies 1960; Aguayo 1975; Mitchell 1975a; Van Bree et al. 1978).

The northern population ranges from Greenland, Iceland, the Barents Sea, and possibly the Baltic sea in the north, to Cape Hatteras in the west, and northwest Africa (including the Mediterranean) in the east (Sergeant and Fisher 1957; Mitchell 1975a; Leatherwood and Dahlheim 1978; Evans 1980; Nores and Perez 1988).

In the eastern Atlantic, *Globicephala melas* appears to be rare in Italian waters, on the coasts of the Netherlands and Belgium, and the east coasts of Britain and Ireland (Evans 1980). It may or may not be present in the North Sea (Leatherwood and Dahlheim 1978; Evans 1980).

In the western Atlantic, it is numerous in the region of Georges Bank, Scotian Shelf, outer Laurentian Channel, and Grand Bank from July - December, but is absent from inshore Labrador waters during summer (Sergeant 1979). *Globicephala melas* is found throughout the Gulf of St. Lawrence, although it seems to be more abundant in the southern portion of the Gulf and along the west coast of Newfoundland (Sergeant and Fisher 1957; Sergeant et al. 1970; Dunbar et al. 1977; Sears et al. 1981; Sears 1982).

*Globicephala melas* is common off the east coast of the U.S., although abundance varies greatly. They are found along the shelf break from Cape Hatteras to the eastern tip of George's Bank (Hain et al. 1981). In summer, they move from the shelf edge onto George's Bank and into the Gulf of Maine (Hain et al. 1981; Powers et al. 1982), although they are present on George's Bank throughout the year. Sightings are most common in the southern New England mid-shelf and shelf-break in fall and winter (Powers et al. 1982).

In the Southern Hemisphere, *Globicephala melas* occurs mainly north of the Antarctic Convergence in the cold currents (Humbolt, Falkland, and Benguela) associated with the West Wind Drift (Mitchell 1975a; Leatherwood and Dahlheim 1978; Van Bree et al. 1978; Guiler et al. 1987; Miyazaki and Kato 1988).

Long-finned Pilot Whales inhabited the Sea of Japan until the 12th century, although there is no recent evidence of them in the Bering sea or North Pacific (Kasuya 1975; Kasuya et al. 1988a). Sometimes, individuals of *Globicephala macrorhynchus* taken off the coast of Japan are mistakenly identified as *Globicephala melas* (Ohsumi 1975; Kasuya et al. 1988a).

*Globicephala melas* appears to be distributed continuously across the North Atlantic (Brown 1961; Leatherwood and Dahlheim 1978). Separate stocks have yet to be conclusively distinguished, although there is some evidence that the western and eastern North Atlantic populations are distinct. Eastern animals appear to be slightly larger, and although the population around Newfoundland was depleted by a drive fishery in the 1960s, the eastern population showed no corresponding decline in numbers (Sergeant 1962; Mercer 1975; Mitchell 1975a,b; Moore et al. 1979; Martin et al. 1987; Bloch 1994). Declines were also not observed in areas near Newfoundland, such as Nova Scotia (Sergeant 1982). This may indicate the presence of subpopulations within the western North Atlantic.

Although there is incomplete census data, Andersen (1988) hypothesized a parapatric distribution between the east and west Atlantic, resulting in a limited exchange of genes between the two areas. Further, differences in the types of parasites carried by pilot whales from the Faroe Islands, the western Mediterranean, eastern North Atlantic waters near France, and Newfoundland, suggest that individual whales may not routinely move between any of these regions (I.W.C. 1990a). However, recent increases in mass strandings reported from both sides of the Atlantic suggest the possibility of a continuous distribution across the North Atlantic (D. E. Sergeant, McGill University, Main Road, Hudson, Quebec; personal communication).

In the eastern Atlantic, enzyme variation within and between schools of whales caught in the Faroes may imply some degree of reproductive isolation among schools (Andersen 1988). Further, differing concentrations of the elements mercury, cadmium, and selenium found among Faroese whales suggests the existence of at least two sub-populations (Jean-Caurant 1987; Julshamn et al. 1987). Faroese pilot whales have been historically classified into

FIGURE 1. Long-finned Pilot Whale, *Globicephala melas*, (Drawing by D. Nelson, approximately 1/50 life size).

one of two types depending upon the shape of the dorsal fin, but these differences are now attributed to yearly variations in blubber thickness (Andersen 1988; Bloch et al. 1994).

In waters of the British Isles, there is some evidence of at least two separate populations; a northerly one which may be part of the stock centered on the Faroes, and a more southerly one (Evans 1980).

## Protection

*International*

Pilot whales are listed on Appendix I of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES).

*National*

*Canada:* All whaling, except aboriginal, is prohibited in Canadian waters under the Marine Mammal Regulations the Fisheries Act of 1867 (as amended to date). Hunting can only be undertaken under license.

*United States:* Protection is afforded under the Marine Mammal Protection Act of 1972 as well as by the Packwood-Magnuson Amendment of the Fisheries and Conservation Act, and the Pelly Amendment of the Fisherman's Protective Act.

## Population Size and Trends

There are inadequate estimations of abundance for the entire northern or southern population of Long-finned Pilot Whales.

*Western Atlantic*

A drive fishery existed at Cape Cod from the mid-1700s to the 1920s, with the mean annual catch in the 1800s on the order of 2000 to 3000 animals (Mitchell 1975b; Mead 1979).

Although *Globicephala melas* was exploited to some extent in Newfoundland even before the 1900s, it became the target species of organized drive fisheries from 1947 to 1971, which took approximately 54 000 animals within this time span (Mercer 1975; Sergeant 1982). Most whales were captured in Trinity Bay and Bonavista Bay, with fewer in Conception Bay and Notre Dame Bay (Sergeant 1962; Mercer 1975).

The population in eastern Newfoundland waters is thought to have numbered 50 000 to 60 000 at the onset of the fishery, and was apparently decimated by the hunt. A peak kill of 10 000 whales in 1956 gave way to a steady decline, until annual catches numbered in the low hundreds (Mitchell 1974; Mercer 1975; Sergeant 1982). The whales were usually herded by boats into shallow bays and killed with lances, although a few hundred were harpooned annually by crews on whaling vessels (Sergeant 1962). In 1971, the company which processed the animals reported to the Department of Fisheries that "Potheads" were virtually commercially extinct in Newfoundland. The drive fishery ended when commercial whaling on the Canadian Atlantic coast was banned by the Government of Canada on December 22, 1972 (Mercer 1975). There is no evidence of depletion in any other stocks of *Globicephala melas*.

Some authors feel that the Newfoundland population may be recovering (Mitchell 1975a; Sergeant 1982), however, there is little new information on the status of the Newfoundland population. The most recent estimates for northeastern populations yield 4000 to 12 000, and sightings are relatively infrequent (Hay 1982; Lynch 1987; I.W.C. 1990b; Lien 1980; Lien et al. 1980; Lien, unpublished data). It is unlikely that recovery is complete. If one assumed a Newfoundland population of 4000 animals in 1972, present numbers estimated from an optimistic 6% net recruitment rate would only be around 12 000 animals.

*Eastern Atlantic*

Statistics on the non-commercial pilot whale drive in the Faroe Islands have been found dating as early as 1584, and an unbroken record exists from 1709 to the present (Bloch et al. 1990a). The annual catch between 1709 and 1989 varied from zero to 4325 whales, with an average of 988 whales caught per year (Bloch et al. 1990a). In 1987, an estimate of 100 000 whales was made for waters east of Greenland, with the most animals occurring southwest of the Faroe Islands (Desportes 1990). There is no evidence of depletion, although uncertainties in abundance numbers and reproductive rates make

assessments tentative (I.W.C. 1990a). Hunting techniques in the Faroe Islands are similar to those that were utilized in the Newfoundland drive fishery (Bloch et al. 1990b).

Small numbers of animals have been taken in Norway, West Greenland, Iceland, Scotland, and Ireland (Christensen 1975; Kapel 1975; Mitchell 1975a,b; O'Riordan 1975; Sergeant 1979; I.W.C. 1990b). Population estimates for eastern Atlantic waters yield approximately 100 000 whales, although there is uncertainty in this number (I.W.C. 1990b).

### Habitat

*Globicephala melas* is a pelagic species which inhabits deep water throughout most of the year, although at times it moves inshore in pursuit of prey (Leatherwood and Dahlheim 1978; Sergeant 1979; Sergeant 1982; Dawson et al. 1985; Martin et al. 1987). Knowledge of habitat use by *Globicephala melas* is fragmentary for most seasons and for offshore areas. Satellite tracking data indicate an affinity for shelf edges (B. Mate, Marine Sciences Center, Oregon State University, Newport Oregon; personal communication).

## General Biology

*Reproductive Capability*

The breeding season of Long-finned Pilot Whales around Newfoundland lasts from May to November, with the maximum number of births occurring in mid-August (Sergeant 1962). A summer breeding season is also found for pilot whales in the Mediterranean. The whales begin to congregate in July and calve by late September. In the Faroes, the average conception date is around June (Evans 1980; Amos and Dover 1990; Desportes 1990). Some animals breed sucessfully year-round, however (Desportes 1990).

A single calf, approximately 180 cm in length and weighing 100 kg is born after a gestation period of about 16 months (Frazer and Huggett 1959, 1973; Sergeant 1962; Martin et al. 1987; Bloch 1994). Twins appear rarely (Bloch 1994). Lactation can last 2.5 years or longer, although weaning and tooth eruption begin at around six months of age (Sergeant 1962; Martin et al. 1987; I.W.C. 1988; Desportes 1990; Bloch 1994). Some whales taken in the Faroes were found to have milk in their stomachs, even though they were over four years old (Desportes 1990). Females can be both lactating and pregnant (I.W.C. 1988; Bloch 1994).

Male pilot whales show a rapid rate of growth until sexual maturity is reached at about 12 years of age, and four to five meters in length (Sergeant 1962; Martin et al. 1987; Kasuya et al. 1988b; Bloch 1994). Growth may be most rapid in the first two to three years of life (Martin et al. 1987; Kasuya et al. 1988b). After sexual maturity is reached, the growth rate for males slows, and may cease at about 20 to 25 years of age (Sergeant 1962; Kasuya et al. 1988b; Bloch 1994). Females show a growth pattern similar to males, although they generally grow a bit slower (Sergeant 1962; Kasuya et al. 1988b; Desportes 1990; Bloch 1994). Females mature at six to 13 years and a length of three to four m (Sergeant 1962; I.W.C. 1988; Kasuya et al. 1988b; Bloch 1994). Males live up to 50 years, while females can live longer than 60 years (Kasuya et al. 1988b; Desportes 1990; Bloch 1994).

One calf is produced about every three or four years (Sergeant 1962; Desportes 1990). At least three ovulations can occur in females during one breeding cycle (Sergeant 1962). Annual pregnancy rate is approximately 30%, (Perrin and Reilley 1984; Bloch 1994), and annual calf production is estimated at 10 to 13% (Sergeant 1962; Harrison 1969; Martin et al. 1987; Desportes 1990). A high reproductive capacity is retained at all ages, with some females surviving to a post-reproductive phase (Sergeant 1962; Martin et al. 1987; Kasuya et al. 1988b; Desportes 1990). This phase can actually begin quite early - one female examined in the Faroes was sexually senile at 28 years — possibly as a result of ovarian exhaustion (Kasuya et al. 1988b; Desportes 1990).

The annual mortality rate of males from age one to eight is about 5.8%, while for females it is 4.5% (Sergeant 1962). Kasuya et al. (1988b), examining the same data as (Sergeant 1962), estimated the mortality rate of males under 25 years of age to be about seven percent, while for females it is much lower at two percent. In young calves the sex ratio is approximately equal, but the difference in mortality rates results in a declining percentage of males as cohorts age; the overall sex ratio at maturity being one male to two or three females (Sergeant 1962; Martin et al. 1987; Kasuya et al. 1988b; Desportes 1990; Bloch 1994). A higher percentage of females than males within a pod is reported from many sources (Sergeant et al. 1970; McLeod 1981; Crespo et al. 1985; Dawson et al. 1985; Martin et al. 1987; Amos and Dover 1990; Bloch 1994), although occasionally, mostly-male or all-male pods are found (Sergeant 1962; Geraci and St. Aubin 1977; Amos and Dover 1990; Desportes 1990). The higher rate of male mortality may result through intraspecific fighting among males (Bloch 1994).

*Species Movement*

Canadian Waters: Around Newfoundland, pilot whales show a marked seasonal variation in distribution. They generally arrive on the Grand Banks in June and remain until late autumn (Sergeant 1962; Mercer 1975; Lien et al. 1980; Lynch 1987) Maximum abundance in summer appears to be along the southeast coast of Newfoundland: they are not as commonly seen in the inshore waters of the

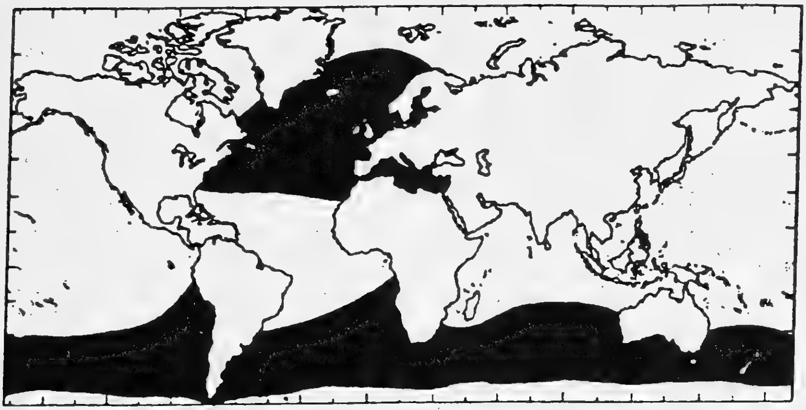

FIGURE 2. Range of the Long-finned Pilot Whale, *Globicephala melas*.

Maritime provinces of Canada or southwards, although they are present (Mercer 1975; Leatherwood and Dahlheim 1978; Hain et al. 1981; Powers et al. 1982; Gaskin 1983). Summer inshore movements of pilot whales around Newfoundland are coincident with the arrival of the Short-finned Squid (*Illex illecebrosus*), which prefer water temperatures in the range of five to 15°C. (Frost and Thompson 1933; Sergeant and Fisher 1957; Lien and Aldrich 1982).

Pilot whales are often sighted in June, and again in October – November, along the continental slope from the entrance of the Gulf of Maine northward to the Laurentian Channel, the southwest edge of the Grand Bank, and the channel between the eastern edge of this bank and Flemish Cap (Sergeant 1962; Lynch 1987). They appear to be absent from this zone in winter (Sergeant 1962).

There have been other widespread summer sightings offshore from New England, Nova Scotia, Iceland, in the Labrador Sea, and over oceanic depths east of the Grand Bank (Sergeant and Fisher 1957; Brown 1961; Mercer 1973, 1975; Boles 1980; Haycock and Mercer 1985; Sigurjonsson and Gunnlaugsson 1989). They may be found off the coast of Cape Cod as early as May (Starrett and Starrett 1955). Apparently, Long-finned Pilot Whales occur only north of 55°N latitude in the summer months, on both sides of the Atlantic (Brown 1961).

Pilot whales migrate outside the Continental Shelf in winter, and are then known to inhabit areas on and east of the Grand Bank in North Atlantic Current waters (Sergeant and Fisher 1957; Sergeant 1962). There have also been winter sightings off New England and Greenland (Sergeant and Fisher 1957; Brown 1961; Mercer 1967, 1975; Parsons 1981).

*Other Areas:* In West Greenland and Iceland, pilot whales generally stay offshore (Sergeant and Fisher 1957; I.W.C. 1990a). In European seas, this species occurs numerously between Iceland, the Norwegian coast and Great Britain in the summer, with its maximum concentration around the Faroe Islands (Sergeant and Fisher 1957; Leatherwood and Dahlheim 1978; I.W.C. 1990a). They are known to pursue squid into Icelandic fjords, and their presence in Faroese waters appears to be related to prey distribution and changes in water temperature (Grimpe 1933; Saemundsson 1939; Bloch et al. 1990a).

There is little evidence to support any strong north-south migrational patterns in the Northern Hemisphere, although a seasonal movement of Southern Hemisphere whales into Antarctic waters has been postulated (Guiler et al. 1987; Martin et al. 1987).

### *Behaviour*

*Feeding:* In Newfoundland coastal waters, *Globicephala melas* subsists mainly on Short-finned Squid, although Northern Cod (*Gadus morhua*) are common prey when squid are less plentiful (Sergeant 1962; Mercer 1975). Other organisms known to be taken in the western Atlantic include the amphipod *Gammarus locusta* and the squids *Loligo pealii* and *Gonatus fabricii* (Sergeant and Fisher 1957; Mercer 1967). When squid is abundant, it has been estimated that food intake may be 3 to 6% of body weight, or as much as 41 kg per day (Sergeant 1962).

Although *Illex illecebrosus* is considered to be the main food item for Long-finned Pilot Whales in the western North Atlantic, individuals of consumable size are only available in the summer months (Mercer 1975). Prey species for the remainder of the year are not known, although oceanic squids (including other species of Ommastrephids) and oceanic fishes are probably candidates (Mercer 1975). Pilot whales have been known to consume Turbot, *Reinhardtius hippoglossoides,* in the winter (Mercer 1967).

Saemundsson (1939) considered *Ommastrephes sagittatus* to be the most commonly ingested squid in northern European waters, although pilot whales feed mainly on the squid *Todarodes sagittatus* off the Faroe Islands (Moore et al. 1979; Desportes 1990; Bloch 1994). Generally, prey species taken in Faroese waters are shoaling, oceanic, mid-water organisms (Desportes 1990). Other squids taken in eastern waters include *Gonatus fabricii*, *Eledone* sp., *Teuthowenia* sp., *Taonius* sp., *Architeuthes* sp., and *Histioteuthis* sp. (Evans 1980; Desportes 1990; Bloch 1994). Fish prey include Blue Whiting (*Micromesistius poutassou*), Northern Cod, Horse Mackerel (*Caranx trachurus*), flounder (Pleuronectidae), and Turbot (Sergeant 1962; Evans 1980; Bloch 1994). Fish and other organisms become more prevalent in the diet of pilot whales when squid are scarce (Desportes 1990; Bloch 1994). Schools of pilot whales are known to associate strongly with mackerel shoals off southwestern England (Evans 1980). There is also a correlation between herring numbers and pilot whale catches for the Faroes, which may result from squid concentrating to feed on the herring (Evans 1980).

Pilot whales apparently feed in a group, as the degree of digestion of squid in stomachs is always the same in groups driven ashore (Sergeant 1962). *Globicephala melas* has been observed feeding in groups and forming circle patterns which may indicate "herding" of squid (Weilgart 1985).

*Social Behaviour:* Pelagic groups of *Globicephala melas* generally consist of about 20 animals, although they may concentrate inshore in much larger numbers sometimes exceeding 200 animals (Sergeant and Fisher 1957; Clarke 1962; Sergeant 1962; Evans 1980; Hay 1982; Weilgart 1985; Amos and Dover 1990). In Newfoundland, groups that are driven ashore or mass strand are generally larger than pelagic assemblages; the mean being 85 animals (Sergeant 1962, 1982). It is speculated that changes in group size may reflect varying behaviours such as feeding, migration, or reproduction, although pod sizes may also be underestimated when observed at sea (Sergeant and Fisher 1957; Sergeant 1962; Evans 1980; Weilgart 1985; Martin et al. 1987).

Schools generally contain animals of various sizes and both sexes (Sergeant 1962; Amos and Dover 1990; Bloch 1994). The social structure of *Globicephala melas* has yet to be conclusively determined, although there is evidence of a matrilineal pod organization (Amos and Dover 1990; I.W.C. 1990a; Desportes 1990). Further, because there is usually more than one mature male in a pod, a multi-male, polygynous mating system seems likely (Sergeant 1962; Martin et al. 1987).

Males probably move frequently between pods; spending only a few months in any particular group (Amos and Dover 1990; Desportes 1990). This movement may begin when the males reach sexual maturity, during which time segregation into separate pods is possible (Kasuya et al. 1988b). All-male or mostly-male herds are rarely observed however, and there is no evidence that this species is generally segregated (Sergeant 1962; Martin et al. 1987; Amos and Dover 1990; Bloch 1994).

*Globicephala melas* is a highly social species, and strong social bonds are often cited to explain mass stranding (Kritzler 1952; Geraci and St. Aubin 1977; Norris and Dohl 1980). Its social nature is also reflected in a rich vocal repertoire, which includes a variety of whistles ranging from 0.5 to 5.0 Khz in frequency, double clicks, and the ability to produce two totally different signals simultaneously (Schevill 1964; Busnel and Dziedzic 1966; Taruski 1979; Herman and Tavolga 1980). Signature whistles and dialects may also exist (Taruski 1979; McLeod 1982).

Sound production is known to vary with behavioural and environmental context (Taruski 1979; Weilgart and Whitehead 1990). Simplest sounds are emitted during periods of minimal activity such as resting behaviour, while more complex sounds occur when behaviour is vigorous and energetic, and involves more complex coordination within the group (Taruski 1979; Weilgart and Whitehead 1990). Differences in calling rate between large and small schools have also been observed (Taruski 1979).

In the summer of 1987, an immature pilot whale was tracked for 95 days in the western North Atlantic through the use of a satellite-monitored radio tag (Mate, personal communication). Information obtained indicated that virtually all deep dives occurred either just before sunset or at night, and coincided with the nocturnal rise of prey items. Since few deep dives were recorded during the day, it was thought that the whale was probably feeding on surface shoaling fish at these times, if it fed at all. The highest swimming speeds were also found at night, suggesting fast prey-chasing or searching. Daily movements of up to 234 km were observed, with a mean of 80 km per day. The average number of dives in a 12 hour period varied from 636 to 1433, reflecting changes in the animal's activity patterns. Swimming speeds averaged 3.3 km/h over the entire period, while speeds above 16 km/h could be maintained for periods exceeding three hours. Surface resting activity, sometimes of up to 15 minutes, was most common during the first three hours of sunrise (Mate, personal communication).

This species has been observed to form mixed groups with Bottlenose Dolphins (*Tursiops truncatus*), White-beaked Dolphins (*Lagenorhynchus albirostris*), Atlantic white-sided Dolphins (*Lagenorhynchus acutus*), Killer Whales (*Orcinus orca*), and Tuna, *Thunnus thynnus* (Sergeant and Fisher 1957; Aloncle 1972; Leatherwood et al. 1976; Leatherwood and Dahlheim 1978; Evans 1980; Sears

1982; Bloch 1994). On occasion, single stray Narwhals, *Monodon monoceros*, have been found associating with groups of *Globicephala melas* (Lien and Barney 1991).

Behaviours such as spyhopping and lobtailing have been observed in pilot whales, while breaching may occur when groups are feeding (Weilgart 1985; Leatherwood et al. 1976). They are not known to ride bow waves (Leatherwood et al. 1976).

## Limiting Factors

### *Parasites*

Although not a serious limiting factor, parasites are common in this species. External parasites include the Whale Louse, *Isocyamus delphini*, which infests crevices in the skin and old wounds, and *Conchoderma auritum*, found on the teeth and gums, usually of older animals (Sergeant 1962; Martin et al. 1987; Balbuena and Raga 1991). The Whale Louse apparently infests mature males more heavily than other classes, possibly due to differences in behaviour of the males (Balbuena and Raga 1991).

Internal parasites include the nematode *Anisakis simplex* which may originate in the stomach from ingested squid, in the nasal passages and middle ear sinuses, and *Crassicauda carbonelli* infesting the penis; also the trematodes *Leucasiella delamurei* and *Odhneriella subtila* from the small intestine, and *Phyllobothium delphini* embedded in the blubber of older animals (Sergeant 1962; Raga and Balbuena 1988, 1990; Balbuena et al. 1989).

Some parasites, such as the trematode *Pholeter gastrophilus* and the nematode *Anasakis simplex* show a decline in older animals, which could suggest that heavy infestation could be a cause of mortality (Desportes 1990).

### *Infections*

The influenza A virus, originating from avian sources, is known to be transferrable to pilot whales (Hinshaw et al. 1986; Chambers et al. 1989). *Streptococcus equi*, an equine pathogen rarely isolated from other animal species, has been found in *Globicephala melas* (Higgins et al. 1980).

### *Pollutants*

Organochlorines and heavy metals have been documented in the tissues of *Globicephala melas* (Taruski 1975; Wagemann and Muir 1984; Muir et al. 1988). Martin et al. (1987) reported higher levels of PCBs in pilot whales stranded along British coasts than have been found in any other populations of this species. Mercury levels in consumable parts of Faroe pilot whales are known to approach or exceed safe limits (Andersen et al. 1987). Contaminants may be transfered from females to their young during pregnancy and lactation (Desportes 1990).

The effects of these pollutants have yet to be determined. However, high concentrations of heavy metals have been suggested as a possible cause for stranding, and high levels of polychlorinated biphenyls have been associated with reproductive failure in other marine mammals (Muir et al. 1988).

### *Predation*

Pilot whales often bear scars, especially on trailing edges of flippers, dorsal fin, and flukes (Sergeant 1962; Martin et al. 1987). Tooth scars, common on adult males, may attest to play or fighting for pod dominance rather than by attempted predation (Martin et al. 1987; Bloch 1994). Sergeant (1962) found no evidence of predation by Killer Whales or sharks for pilot whales around Newfoundland, although Killer Whales are known to prey on them in other areas (Katona et al. 1988). Sucker marks have also been observed, and are probably made while the whale is feeding on squid (Sergeant 1962; Martin et al. 1987; Bloch 1994).

### *Mass Strandings*

*Globicephala* is the genus that most frequently mass strands. Such strandings sometimes involve entire pods (Geraci and St. Aubin 1977; Evans 1980; Sergeant 1982). Mass strandings of Long-finned Pilot Whales have been recorded from Ireland, Britain, France, Spain, New Zealand, South America, New South Wales, the Netherlands, Greenland, Newfoundland, Nova Scotia, Cape Breton Island, Sable Island, Prince Edward Island, Magdalen Islands, Miquelon Island, and Cape Cod (Starrett and Starrett 1955; Dawbin 1964; Sergeant et al. 1970; O'Riordan 1975; Husson and Van Bree 1976; Mead 1979; Sergeant 1979; Wood 1979; Nores and Perez 1982; Sergeant 1982; Crespo et al. 1985; Dawson et al. 1985; Sheldrick 1989; Kingsley, unpublished data). Table 1 lists reported mass strandings for eastern Canadian waters between 1957 and 1990.

A rough estimate of annual mortality due to mass strandings in Newfoundland from 1975 to 1980 is about one percent of the population, and mass strandings seem to be increasing (Sergeant 1982). Recently, pilot whales have begun to strand almost yearly around Cape Cod (Sergeant, personal communication). Sheldrick (1979) and Brown (1975) report an increase of pilot whale strandings on the British coast beginning in 1947, although their data included single-stranded animals. A more recent study suggests that British mass strandings have increased since about 1982 (Sheldrick 1989). Further information is needed to estimate the effect of mass strandings on pilot whale populations. It is possible that mass strandings represent the main source of coastal mortality for this species (Sergeant 1982).

### *Incidental Catches*

Incidental catches of *Globicephala melas* in fishing gear have been frequently observed (Lien and Aldrich 1982; I.W.C. 1990a; Donovan and Perrin 1990; Kraus et al. 1990; Northridge 1990; Stenson

TABLE 1. Mass strandings of *Globicephala melas* for eastern Canadian Waters between 1957 and 1990. All reported strandings of more than one animal are listed (Kingsley, unpublished data).

| Year | Date | No. | Locality | Remarks | Source |
|---|---|---|---|---|---|
| 1957 | 4 August | 12 + | Cow Head, N | Fall died | Sergeant et al. 1970 |
| 1959 | 2 October | 18 | Sable Island, N.S. | refloated on later tide | Sergeant et al. 1970 |
| 1960 | 1 August | 58 | Port Maitland, N.S. | all died | Sergeant et al. 1970 |
| 1967 | 24 December | 15 | Glace Bay, Cape Breton Island, N.S. | all died | Sergeant et al. 1970 |
| 1975 | 28 September | 300 | Charleston, Bonavista Bay, NF | 200 whales towed out, many smaller whales restranded, approx 125 died | Mitchell 1977 |
| 1976 | 26 December | 130 + | Sable Island, N.S. | 116 examined | Geraci and St. Aubin 1977 |
| 1978 | 17 September | 63 | Miquelon Island | scattered over 1 mile of sandy beach | Mitchell 1980 |
| 1978 | 19 September | 99 | Pte aux Allouettes, Miquelon Island | dead in two tight groups | Mitchell 1980 |
| 1978 | 29 September | ca. 70 | Musgrave Harbour, Bonavista Bay, NF | fishermen towed many into deep water, approx. 54 died | Mitchell 1980 |
| 1979 | 14 July | 135 | Point aux Gaul, NF | all died | Lien 1980 |
| 1980 | 18-19 October | 75 | Point Leamington, NF | all died | Lien 1980 |
| 1980 | 25 October | 18 | Grand Beach, NF | all died | Lien 1980 |
| 1980 | 9-18 November | 52 | Bedeque Bay, PEI | all died | Mitchell 1982 |
| 1981 | 31 August | 39 | Little Burnt Bay, Notre Dame Bay, NF | all died | Lien and Aldrich 1982 |
| 1981 | 4 September | 2 | Chance Cove Trinity Bay, NF | both died | Lien and Aldrich 1982 |
| 1981 | 4 September | 5 | Branch St. Mary's Bay, NF | all died | Lien and Aldrich 1982 |
| 1981 | 6 Sepember | 27 | George's Bay, NS | 13 died, remainder released | Loch 1983 |
| 1981 | 8 September | 70 | Port Hood, George's Bay, N.S. | 25-30 died | Loch 1983 |
| 1981 | 13 October | 13 | Magdalen Islands | all died | Loch 1983 |
| 1981 | 27 July | 23 | Grand Bank, NF | 12 unbeached themselves, 11 died | Lien et al. 1982 |
| 1982 | 18 August | 3 | Bonavista, NF | 2 unbeached, 1 died | Lien et al. 1982 |
| 1982 | 13 August | 14 | Pinkney's Pt., Yarmouth N.S. | 12 released, 2 died | Goodman 1984 |
| 1990 | 9 August | 2 | Cheticamp, N.S. | ca. 40 whales attempted to strand but were successfully repelled, 2 died | Tom Kiely, *in litt.*, 10 Aug 1990 |
| 1990 | 15 September | 2 | Sturgeon Bay, PEI | female and young moved to deeper water, female restranded on 16th, euthanized | R.P. Johnston, DFO Charlottown, in litt., 19 Sep 1990 |
| 1990 | ca. 30 September | 2 | S. Lakevale, N.S. | males, dead when found | Kingsley, *personal communication* |

and Reddin 1990). Catches often involve younger and smaller animals which cause little damage to the fishing gear. Because of this, there is a tendency to under-report catches (Lien and Aldrich 1982; Lien et al. 1994). Further, in some jurisdictions where there are regulatory problems stemming from incidental catches, fishermen may try to avoid reporting animals that have been caught (Prescott et al. 1980).

Lien and Aldrich (1982) investigated incidental catches of *Globicephala melas* in Newfoundland during 1983, a year of high squid abundance. The whales were commonly found in traps set for squid, although they also became caught in groundfish and herring gillnets. Of 43 animals reported entrapped, 87% died as a result of the entrapment. It was suggested that entrapments were probably more likely to be reported by fishermen in 1983 because they

occurred in a small area and were considered a major problem in the fishery. Since 1983, inshore abundance of *Globicephala melas* has been quite low, and it is probable that isolated entrapments would not be reported (Lynch 1987; Lien et al. 1994).

*Other*

The exploitation of prey species by various fisheries may have an impact on populations of *Globicephala melas*, although such effects have yet to be documented for this species (Lowry and Frost 1985).

## Special Significance of the Species

*The Faroese Fishery*

The non-commercial pilot whale hunt, or "grind" is an integral part of the traditions and culture of the Faroe Islands (Olafsson 1990). In recent years a high level of controversy has surfaced which involves ethical, ecological, and animal-welfare issues (Gibson-Lonsdale 1990; Joensen 1990; Olafsson 1990). In addition, high concentrations of mercury found to be present in consumable tissues has raised significant health questions (Andersen et al. 1987; Olafsson 1990).

The pilot whale fishery of the Faroes does offer an excellent opportunity for studying the biology and social structure of these animals, as statistics have been kept as far back as 1584, and represent information about entire pods of whales (Desportes 1990; Bloch 1994). A newly-developed technique which may prove invaluable for answering questions about population biology is that of DNA fingerprinting, which can accurately assess paternity of individual animals (Amos and Dover 1990). DNA fingerprinting is a more accurate method for examining population structure than the use of coded tags or naturally occurring markings, because these offer only indirect evidence about breeding systems (Kaufman et al. 1987; Amos and Dover 1990). At the present time, data are being gathered with this technique from the Faroese fishery which will eventually provide information concerning individual movement between pods, age at first breeding, length of time spent within pods, and the relatedness of individuals within pods (Amos and Dover 1990).

*The Phenomenon of Mass Stranding*

As *Globicephala* is the genus that most frequently mass strands, *Globicephala melas* is a common subject for the study of this phenomenon (Geraci and St. Aubin 1977; Evans 1980; Sergeant 1982; Kirschvink 1990). No conclusive evidence yet exists as to the causes of mass strandings. Parasitism has been suggested as a possible factor (Dailey et al. 1979; Wood 1979; Morimitsu et al. 1986), yet it appears that mass-stranded animals are generally not diseased or highly parasitized (Geraci 1979; Hall and Schimpff 1979; Ridgway 1979; Sergeant 1979; Wood 1979; Sergeant 1982; Morimitsu et al. 1986). Other speculations include confusion due to lack of familiarity with inshore waters, disturbances to the echolocation system because of an area's underwater topography, problems in attention, anomalies in geomagnetism, or general stress from any number of possible sources (Geraci and St. Aubin 1979; Wood 1979; Dawson et al. 1985; Kirschvink 1990).

As mass strandings of Odontocete species apparently occur where the animals are abundant, a better understanding of the phenomenon could provide evidence on the state of various populations (Sergeant 1979; Sergeant 1982).

*Satellite Tracking*

The development of satellite-monitored radio tracking represents another important breakthrough in the study of whale behaviour. A feasible monitoring system was first used in 1987 to record the behaviour of a pilot whale for 95 days in the western North Atlantic (Mate, personal communication). The pilot whale is a useful model for tracking studies because it is found in a variety of environments, its trophic niche is typical of many odontocetes, and it is easily captured (Mate, unpublished data). At the present time, satellite systems are still under development; they may eventually provide information including stock separation, energetics, acoustics, and the identification of critical habitats (Mate 1989).

## Evaluation

*Globicephala melas* is widespread, and although numbers are considerably lower than prior to commercial whaling, they are still relatively abundant in the North Atlantic. Although there may be several sub-populations in Canadian waters which are somewhat distinct, exact relationships are unclear. It is known that *Globicephala melas* off Newfoundland was severely depleted by drive fisheries which ended in 1971. There have not been systematic efforts to assess populations and their recovery since that time. Even optimistic estimates would indicate that numbers are still low and well below pre-whaling population size. Mass strandings represent a major known source of natural mortality for this species. The effects of incidental entrapments, pollutants, and fisheries for prey species remain relatively unknown, but these factors have the potential for limiting this species. Although this sub-population would meet the criteria for a COSEWIC designation of vulnerable, if considered without regard to other North Atlantic populations, there is no evidence that the population is distinct and discrete. Therefore, since the species is widespread and relatively abundant throughout the Western North Atlantic, such a designation cannot be made since Western North Atlantic populations would not seem to be at risk, although numbers have not recovered to pre-whaling levels.

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# The Status of the Pygmy Sperm Whale, *Kogia breviceps*, in Canada*

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The general biology, world-wide status and management of the Pygmy Sperm Whale, *Kogia breviceps*, with special reference to its status in Canadian waters, is reviewed. Pygmy Sperm Whales appear to be uncommon in Canadian waters; there are several unconfirmed sighting records off British Columbia and only four stranding records off the Canadian east coast. Little is known about its biology or world-wide status, and although it is taken in small numbers both directly and incidentally in fisheries, no serious threats to its status are apparent. No COSEWIC designation is required regarding its status in Canadian waters.

Le présent rapport résume la biologie générale, le statut international et la gestion du Cachalot Pygmée, *Kogia breviceps*, et s'attache plus particulièrement à son statut dans les eaux canadiennes. Le Cachalot Pygmée semble être une espèce inhabituelle dans les eaux canadiennes; il existe plusieurs mentions visuelles de cachalots au large de la Colombie-Britannique, mais aucune n'a été confirmée. En outre, on ne dispose que de quatre mentions de spècimens échoués le long de la côte est du Canada. On ne connaît que peu de détails au sujet de sa biologie ou de son statut international. Bien que le Cachalot Pygmée soit capturé en petit nombre, que ce soit directement ou comme prise fortuite par les echeurs, il ne semble y avoir aucune menace grave à son statut. Son statut dans les eaux canadiennes ne nécessite donc aucune désignation par le CSEMDC.

Key Words: Pygmy Sperm Whale, Cachalot Pygmée, *Kogia breviceps*, Canada, North Atlantic, British Columbia, status, Cetacea.

Little is known about the Pygmy Sperm Whale, *Kogia breviceps* (de Blainville, 1838) [Figure 1]. We summarize here the current state of knowledge of the species, with special reference to its status and management in Canadian waters. There are two species within the genus *Kogia*: *Kogia breviceps*, and the Dwarf Sperm Whale, *Kogia simus*. Before 1966, however, most authors recognized one species, *Kogia breviceps*, within the genus (Yamada 1954; Handley 1966), resulting in considerable confusion as to which species is actually referred to in early publications. This taxonomic uncertainty can be attributed to the similarity of the two species and the scarcity of specimens. Both taxa are small (less than 3.8 m), have a small, underslung shark-like mouth which is set well back from the tip of the snout. They are dark bluish-gray dorsally and shade from a lighter gray laterally to a dull white or pink on the belly (Leatherwood and Reeves 1983; Nagorsen 1985). Both have a bulbous head and, like the other member of the Family Physeteridae, the Sperm Whale (*Physeter macrocephalus*), they have a spermaceti organ (Handley 1966). The tail stock is elongated and laterally compressed, and the flukes are notched and concave along the rear margin. Stranded specimens of both species are occasionally confused with sharks, due to the shark-like mouth and the presence of a lightly pigmented bracket-shaped mark on each side of the head between the eye and flipper, sometimes referred to as "false gills" (Figure 1).

The two species can be discriminated by a variety of external and cranial characters (*see* Table 1). Many authors note that they can be distinguished by the position of the dorsal fin on the back, set well posterior to the midpoint of the back for the Pygmy Sperm Whale and with the anterior insertion of the fin near the midpoint of the back for the Dwarf Sperm Whale, but Ross (1979) cautioned against using this character in isolation, as there is considerable individual variation in both species. Pygmy Sperm Whales reach a greater length than Dwarf Sperm Whales, but the maximum length attained by *Kogia breviceps* is unclear. Caldwell et al. (1971) reported an individual of 4.25 m, but Ross (1979) suggested that the length may have been estimated, rather than measured. According to Ross (1979) the

*Reviewed and Approved by COSEWIC 14 April 1994, report accepted no status designation required.

next-largest recorded specimen was 3.5 m in length. Leatherwood et al. (1988) noted that Pygmy Sperm Whales may grow to a maximum length of at least 3.7 m, and Eliason and Houck (1986) reported an animal 3.82 m in length from the records of the Smithsonian Institution. The taxonomic position of the genus *Kogia* within the Odontoceti is unclear (e.g., see Rice and Wolman 1990).

## Distribution

The Pygmy Sperm Whale is found virtually world-wide in tropical and warm-temperate seas. In the western Pacific it has been reported from Japan in the north to New Zealand and Australia in the south (Omura and Takahashi 1981; Baker 1983; Brabyn 1991), and in the eastern Pacific from Washington State in the north to Peru and Chile in the south (Allen 1941; Scheffer and Slipp 1948; Hubbs 1951; Brownell 1969; Waerebeek et al. 1987). Pike and Giovando (1963) stated that Pygmy Sperm Whales were known to occur in the offshore waters of British Columbia, but we could find no documented records from the Canadian west coast. Four unconfirmed sighting reports are listed as *Kogia breviceps* from the British Columbia coast (Baird unpublished data), but positive confirmation awaits photographs or a specimen. Three records are confirmed from the adjacent waters of Washington State (Scheffer and Slipp 1948; Everitt et al. 1979; Osborne et al. 1988) and it is likely that this species will eventually be documented in B.C. *Kogia simus* has been recorded in British Columbia (Nagorsen and Stewart 1983).

In the western Atlantic, Pygmy Sperm Whales have been recorded from Canada southward along the United States east coast, throughout the Gulf of Mexico, and as far south as Brazil, Uruguay and Argentina (Piers 1923; Allen 1941; Gunter et al. 1955; Carvalho 1967; Hysmith et al. 1976; Geise and Borobia 1987). Four stranding records have been reported on the Canadian east coast (Figure 2; Table 2). Three of these were from Canadian waters, and one from the French Island of Miquelon (Piers 1923; Sergeant et al. 1970; Nelson et al. 1991). These are the most northern records in the western Atlantic. In the eastern Atlantic this species has been recorded from Ireland, the Netherlands and France south to South Africa (Allen 1941; Fraser 1974; Maul and Sergeant 1977; Teixeira 1979; Ross 1984). Pygmy Sperm Whales are found in the Indian Ocean (Leatherwood and Reeves 1989; Chantrapornsyl et al. 1991) but do not appear to have been recorded in the Mediterranean Sea (Baccetti et al. 1991).

## Protection

*International*

The Pygmy Sperm Whale is listed under Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora 1973 (CITES) (see Birnie 1982). Such a listing allows for the regulation of international trade between members and non-members of the convention by requiring export permits from the country of origin. However, there appears to be no current international trade in Pygmy Sperm Whale products. The International Whaling Commission (IWC) regulates the taking of whales in accordance with the current Schedule provisions, but whether this Commission's mandate covers the Pygmy Sperm Whale is unclear, as members of the Commission are divided as to whether "whale" refers to all cetaceans, or to only some species (Klinowska 1987, 1991).

*National*

*Canada:* Until they were repealed in 1993, the Cetacean Protection Regulations of the Fisheries Act of Canada of 1867 protected all cetacean species from "hunting". "Hunting" was defined as "to chase, shoot at, harpoon, take, kill, attempt to take or kill, or to harass cetaceans in any manner", and could only be undertaken under licence. Aboriginal "hunting" however could be undertaken without licences. The Cetacean Protection Regulations were replaced with the Marine Mammal Regulations of the Fisheries Act in early 1993. These regulations appear to provide no more or no less protection, by stating only that "no person should disturb a marine mammal except when ... under the authority of these Regulations". No provisions exist for regulation of incidental catches in fishing operations. Canada is not currently a member of the International Whaling Commission, having withdrawn in 1982 (IWC 1982).

TABLE 1. Distinguishable characteristics of *Kogia breviceps* and *Kogia simus* (Ross 1979; Leatherwood et al. 1988).

| Characters | *Kogia breviceps* | *Kogia simus* |
|---|---|---|
| Maximum length[1] | 3.8 m | 2.7 m |
| Throat creases | absent | usually present |
| Dorsal fin height | usually less than 5% total body length | usually greater than 5% total body length |
| Dorsal fin position[1] | posterior to mid point of back | near midpoint of back |
| Relative snout length | longer | shorter |
| Teeth in upper jaw | absent | up to 3 pairs |
| Teeth in lower jaw | 10–16 pairs | 8–13 pairs |

[1]See text for further details.

FIGURE 1. Pygmy Sperm Whale. Illustration by Dawn Nelson.

*United States:* All cetaceans are protected through the Marine Mammal Protection Act of 1972, as well as through the Packwood-Magnuson Amendment of the Fisheries and Conservation Act and the Pelly Amendment of the Fisherman's Protective Act.

## Population Size(s) and Trends

In the recent IUCN Cetacean Red Data Book, Klinowska (1991) noted that there is insufficient information to accurately classify the world status of this species. No information is available on population sizes or trends, nor on stock identity. In fact, very few sightings of either species of *Kogia* have ever been reported, and knowledge of both species comes largely from stranded animals. In some areas, Pygmy Sperm Whales are among the most frequently recorded stranded species. For example, Odell (1991) noted that they are the second most frequent to strand in the southeastern United States; off the Hawaiian Islands the Pygmy Sperm Whale is the fourth most frequently stranded species (Nitta 1991). In his analysis of strandings in New Zealand, Brabyn (1991) noted that although they do not represent the largest number of individuals (as mass strandings are infrequent), Pygmy Sperm Whales are the most frequently recorded species. Many authors have interpreted these frequent strandings as evidence that this species is fairly common. Recent numerous aerial sightings of *Kogia* (not discriminated to species) in the northern Gulf of Mexico seem to support this supposition (Jefferson et al. 1992).

Only four strandings have been reported off the Canadian east coast and it appears that Pygmy Sperm Whales become more common in the south, with a greater number of records reported off the northeast U.S. coast (Early and McKenzie 1991).

## Habitat

Pygmy Sperm Whales generally inhabit offshore waters in warm temperate and tropical areas. Brabyn (1991) suggested that the Mahia Peninsula area of the north island of New Zealand is a calving area for this species, based on a high proportion of mother/calf strandings. However, information on the habitat type is not presented. Klages et al. (1989) noted that both species in the genus feed on prey typical of the continental slope, although *Kogia simus* feeds more inshore than *Kogia breviceps*.

## General Biology

*Reproduction*

Very little is known about the reproductive biology of this species. Most estimates of reproductive parameters are based on the examination of a small number of stranded animals, and should be considered preliminary. Ross (1979) suggested that mating and calving occur from autumn through spring, and noted that while there was insufficient data to accurately estimate gestation, two alternative methods suggest a duration between seven and 11 months. Individuals have been recorded as being simultaneously pregnant and accompanied by a calf, indicating that some females may breed annually (Ross 1979; Price et al. 1984; Eliason and Houck 1986). Ross (1979) reported that length at birth averages about 1.2 m, sexual maturity is attained at about 2.7 to 2.8

TABLE 2. Records of *Kogia breviceps* from the Canadian east coast. All records are of single animals, found dead. No confirmed records from the Canadian west coast have been reported.

| Date | Location | Source |
|---|---|---|
| 17 January 1920 | Halifax Harbour, Nova Scotia | Piers 1923[1] |
| 29 January 1969 | Sable Island, Nova Scotia | Sergeant et al. 1970 |
| 8 October 1990 | Isle de Miquelon | Nelson et al. 1991 |
| 8 December 1992 | Saint John, New Brunswick | McAlpine and Murison, in preparation |

[1]Katona et al. (1983) report a dead animal found under the ice in Halifax Harbour, Nova Scotia, in the winter of 1970, but this appears to be a misprint, referring to the animal found under similar circumstances in 1920.

m for females and 2.7 to 3.0 m for males, and physical maturity is reached at lengths of 3.0 to 3.3 m for both sexes. The sex ratio of stranded animals varies. Brabyn (1991) found that of 79 Pygmy Sperm Whales that stranded in New Zealand, there were more than twice as many females as males. Off South Africa, the sex ratio of 16 adult and sub-adult animals was 1:1, while the sex ratio for 15 foetuses and calves was heavily biased towards males (12 males: three females) [Ross 1979]. Such disparate figures likely arise from the small sample sizes, and clearly more information is needed.

Ross (1979, 1984) and Eliason and Houck (1986) discussed sectioning teeth for age determination, but no information is available to calibrate the deposition rate of layers. Ross (1984) noted that one sexually mature female which stranded with a calf had only 3.5 growth layers in the dentine. Assuming that one layer is deposited annually, this would imply the female was only about two years old when she first conceived (Ross 1984). No information on longevity is available.

*Movements*

Strandings off South Africa and the U.S. southeast coast occur throughout the year, possibly suggesting a lack of seasonal movements (Ross 1979; Leatherwood and Reeves 1983). Off South Australia however, Kemper and Ling's (1991) analysis of stranding records indicates the presence of Pygmy Sperm Whales only during April through October. In the eastern North Pacific the majority of records are concentrated during the fall and winter (Eliason and Houck 1986), and along the coast of Europe, Fraser (1974) suggested that this species follows the North Atlantic current extension of the Gulf Stream in search of food. There is also evidence for a possible seasonal movement of *Kogia breviceps* near the west coast of New Caledonia, as strandings there occur mainly between June and December (Sylvestre 1988).

*Behaviour*

Behavioural observations are based on a few sightings at sea and on instances where individuals have been kept in captivity after stranding alive (e.g., see Sylvestre 1983). Pygmy Sperm Whales are seen singly or in groups of up to about six individuals (Allen 1941; Vidal et al. 1987; Leatherwood et al. 1988), and do not appear to regularly associate with other species of cetaceans or with seabirds (Au and Pitman 1988). Surface behaviour is typically undemonstrative; individuals typically rise slowly to the surface, produce an inconspicuous blow, and dive without showing the flukes. They are occasionally observed lying still at the water's surface with the top of the head and back exposed. Allen (1941) noted that animals at the surface appeared to be very easy to approach closely, even after being harpooned. However, as with several other species of cetaceans, Pygmy Sperm Whales may release a cloud of reddish brown feces into the water when startled (Leatherwood et al. 1988). The function of this behaviour is unclear, although Scott and Cordaro (1987) observed a Dwarf Sperm Whale mother and calf pair exhibiting this behaviour while trapped inside a tuna purse-seine net, and then apparently hiding within the cloud when approached by dolphins which were also trapped.

Pygmy Sperm Whales appear to feed primarily on cephalopods, as well as crustaceans and fish. Cephalopods recorded from stomach contents of this species include *Abralia* sp., *Abraliopsis* sp., *Ancistrocheirus* sp., *Galiteuthis* sp., *Histioteuthis* sp., *Loligo vulgaris*, *Lycoteuthis diadema, Moroteuthis* sp., *Octopoteuthis cyeletron, Ommastrephes* sp., *Onychoteuthis boreali-japonicus, Phasmatopsis* sp., *Pygropsis* sp., *Pyroteuthis* sp., *Sepioteuthis australis, Taningia* sp., *Taonius pavo, Todarodes* sp., *Tuethowenia pellucida*, and *Vampyroteuthis* sp. (Hale 1947; Raun et al. 1970; Ross 1979; Eliason and Houck 1986; Klages et al. 1989). Crustaceans recovered include *Aristaeomorpha foliacea, Carcinides maenas, Gnathophausia ingens, Goneplax angulata, Hymenodora* sp., *Pandalopsis* sp., *Pandalus* sp., *Pasiphaea pacifica*, and *Penaeus californiensis* (Allen 1941; Hale 1947; Scheffer and Slipp 1948; Raun et al. 1970; Ross 1979; Vidal et al. 1987). Fish recorded include *Lampanyctus* sp., *Maurolicus muelleri, Photichthys argenteus, Pyrosoma* sp., *Rexea solandri, Scopelopsis multipunctatus*, and *Symbolophorus* sp. (Ross 1979, 1984). Raun et al. (1970) also noted the seaweed *Sargassum* from the stomach of a stranded animal, but suggest that this may have been ingested accidentally. An isotope analysis of muscle tissue from a stranded animal off Miquelon suggested that the animal had been feeding at the same trophic level as Sperm Whales; i.e., it had probably been feeding on squid in offshore waters (Nelson et al. 1991). This species likely uses echolocation to find prey, as echolocation-type clicks have been recorded from live-stranded animals (Caldwell and Caldwell 1991).

## Limiting Factors

Data on natural mortality are scarce. There are no reported observations of Killer Whales (*Orcinus orca*) attacking Pygmy Sperm Whales (Jefferson et al. 1991), but the species has been recorded from the stomach contents of Killer Whales from both the Caribbean and the Indian Ocean (Perrin 1982). Long (1991) noted an apparent attack by a White Shark (*Carcharodon carcharias*) on a Pygmy Sperm Whale off California. Information on other causes of natural mortality is sparse. Virtually all recorded strandings of this species are of single animals or of cow/calf pairs. In New Zealand, Robson (1984)

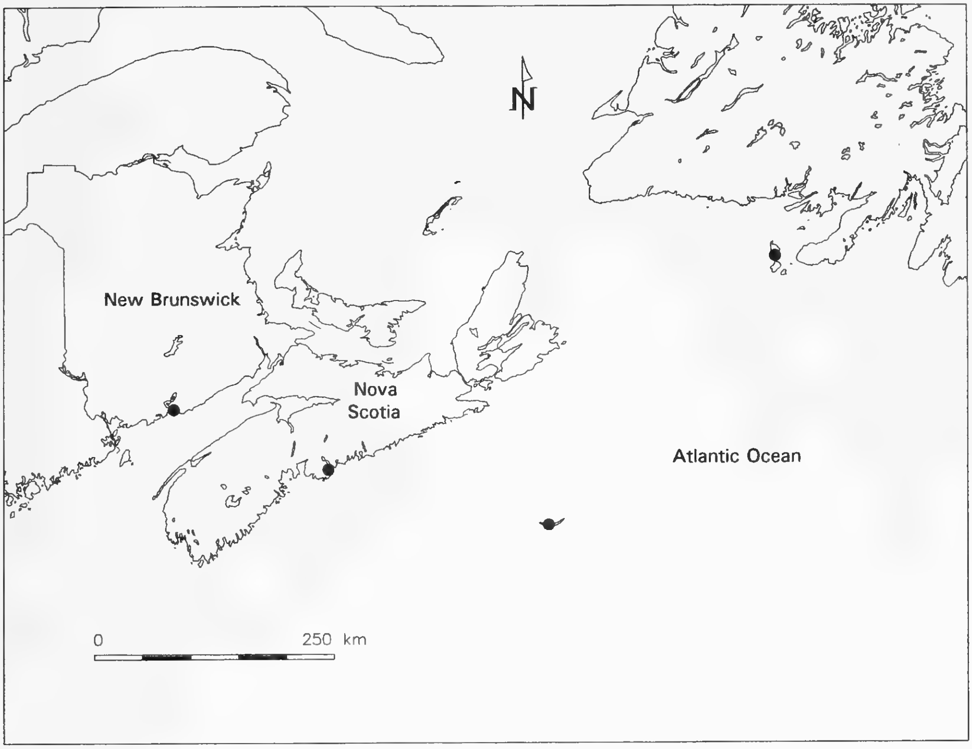


FIGURE 2. Records of *Kogia breviceps* off the Canadian east coast. See Table 2 for details of records.

reported one case of three dead individuals found together on a beach, in association with seven stranded False Killer Whales (*Pseudorca crassidens*), and Brabyn (1991) described a stranding of four individuals. Robson (1984) attributed many of the single strandings of this species to heavy infestations of parasites in the head and inner ear. Parasites recorded from this species include the cestode *Phyllobothrium delphini*, and the nematodes *Anisakis physeteris, Anisakis typica, Anisakis simplex, Phocanema kogiae, Stenurus* sp., *Terranova* sp., and possibly *Crassicauda* sp. (Zam et al. 1971; Ross 1979; Vidal et al. 1987). Buck (1984) noted the presence of the bacteria *Enterobacter agglomerans, Enterobacter cloacae, Pseudomonas cepacia, Pseudolmonas maltophila, Bacillus, Flavobacterium*, and the yeasts *Rhodotorula pallida, Rhodotorula rubra, Torulopsis*, and *Aureobasidium*, but the role of such pathogens in natural mortality is unknown. Severe vascular disease, including thrombus formation, has been noted in one animal (Roberts et al. 1964, cited in Sweeney and Ridgway 1975).

There appear to be no known major threats (past or present) to this species (Klinowska 1991). Small numbers of Pygmy Sperm Whales have been taken in fisheries, both directly and incidentally. In previous years, *Kogia* have been taken by shore-based whaling operations off Japan, but it is unclear if both species were included (Yamada 1954). Edmondson (1948) noted one animal which was speared, and another accidentally hooked and landed while fishing with a hand line off Hawaii. Van Waerebeek et al. (1987) found a specimen in a dump in Peru where the remains of fish and dolphins taken deliberately for human consumption were discarded. One animal was illegally killed in Australia in 1989 (Australia 1991). Whalers in the Timor Sea, Indonesia, have hunted *Kogia* (Weber 1923), although there is no evidence that they have been taken in recent years (Barnes 1991). *Kogia*, probably including *Kogia breviceps*, have been and probably still are taken occasionally in the Lesser Antilles (Caldwell and Caldwell 1975; Reeves 1988). Vidal et al. (1990) noted that Pygmy Sperm Whales were recorded caught in gillnet fisheries in Mexican or Central American waters, but presented no details on exact locations or numbers. This species is taken in directed fisheries and incidentally in gillnet and seine fisheries in the Philippines (Aragones et al. 1991; Dolar et al. 1991). Animals have also been caught incidentally in gillnets in the central North Pacific and off Sri Lanka (Omura et al. 1984; Leatherwood and

Reeves 1989). Ingestion of foreign objects (Jones 1984; Ross 1979, 1984) and boat collisions (Sylvestre 1988) may occasionally result in mortality. Little has been reported on levels of environmental contaminants in this species (Cockcroft et al. 1991).

## Evaluation

Based on existing information the Pygmy Sperm Whale appears to be only a rare visitor to Canadian waters. No serious threats to its status in Canadian waters are apparent. As such, no COSEWIC status designation is required.

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# Notes

## Tree-climbing by Arctic Ground Squirrels, *Spermophilus parryii*, in the Southwestern Yukon Territory

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Arctic Ground Squirrels (*Spermophilus parryii*) are commonly considered obligate ground-dwelling. However, seventy-eight Arctic Ground Squirrels were seen climbing or sitting in spruce trees and on deadfall and stumps 164 times in the the southwestern Yukon from 1991-1994. Trees, deadfall, and stumps, seemed to serve primarily as temporary refuges and/or predator surveillance sites, although some were occasionally used as nest sites. Arctic Ground Squirrels are not as obligate ground-dwelling as previously thought.

Key Words: Arctic Ground Squirrel, *Spermophilus parryii*, climbing, nesting, boreal forest, Yukon.

The Arctic Ground Squirrel (*Spermophilus parryii*) lives in a variety of habitats in North America ranging from Arctic and alpine tundra to boreal forest (Banfield 1974). This species has, however, only been previously studied in tundra habitats where it is considered to be obligate ground-dwelling (Carl 1971; Green 1977; Woods 1980; McLean 1981; Lacey 1991). In the boreal forest, Arctic Ground Squirrels must not only contend with relatively high levels of predation (Hubbs and Boonstra, unpublished), but compensate for an obscured view of approaching predators. Here, we report on climbing of trees, deadfall, and stumps by Arctic Ground Squirrels within the Boreal Forest of the southwestern Yukon Territory (61°N, 138°W).

Squirrels were observed from mid-April, when they emerged from hibernation, to late August, when they entered hibernation, on five 10 ha grids between 1991–1994 and on two additional 10 ha grids between 1992–1994. All grids were dominated by White Spruce (*Picea glauca*) with an understory of Bog Birch (*Betula glandulosa*), Grey Willow (*Salix glauca*), and grasses (*Festuca altacia* and *Calamagrostis lapponica*). Observations of squirrels climbing or sitting in live or dead trees, or on deadfall and stumps greater than 1 m high were made during live-trapping and telemetry sessions.

Seventy-eight of a possible 400 Arctic Ground Squirrels captured on the grids from 1991–1994 (19.5%) were observed in trees or on deadfall and stumps 164 times. These included 49 females (25 adults, 24 young-of-the-year), 16 males (7 adults, 9 young-of-the-year) and 13 young-of-the-year of unknown sex. Squirrels were seen on average, 2.5 times + 0.3 SE (median 1; maximum 13) per individual, at aboveground heights of 1.8 m + 0.2 SE (range 0.5 m - 6.0 m). Squirrels were most frequently seen on deadfall (112 sightings), followed by trees (48 sightings with 21 in live trees and 27 in dead trees), and stumps (4).

The majority of climbing events (156 or 95% of the total sightings) were observed when squirrels were approached by an observer, usually when squirrels were away from their burrows or when their burrow entrances were not readily accessible upon release from traps. Alarm calling frequently occurred once squirrels were in trees or atop deadfall and stumps. This suggests that squirrels used these structures as temporary refuges against potential predators, as has been reported for Woodchucks (*Marmota monax* — Bowdish 1922; Cleveland 1922; Swihart 1982) and small mammals (Jedrzejewski et al. 1992), or as surveillance sites from which to monitor predator movements with the least visual obscurity. Columbian Ground Squirrels (*S. columbianus*) and Beldings Ground Squirrels (*S. beldingi*) have also been reported to use aboveground structures (rocks, burrow mounds, and fence posts) for vigilance (Tyser 1980; Sherman 1985; MacHutchon and Harestad 1990).

The remaining 5% of climbing events involved six female squirrels (five adults, one young-of-the-year)

which appeared to be nesting within 1.5–2.0 m high woodpecker or Red Squirrel (*Tamiasciurus hudsonicus*) holes in dead spruce trees. Nesting was suggested by a squirrel's repeated presence in trees prior to morning emergence as determined from radiotelemetery and by the lactating status of four of the five adults. This behaviour was observed on only one grid with very high numbers (55–216 squirrels versus 7–119 on the other grids from 1991–1994; Hubbs and Boonstra, unpublished; A. Byrom, unpublished; T. Karels, unpublished) where burrow sites likely were limiting.

Other than sites for nesting, refuge, or surveillance, squirrels may climb trees to obtain food, as observed for Woodchucks (D. M. Jedlicka, unpublished). Arctic Ground Squirrels will climb shrubs to feed on the buds, leaves, and flowers as will Columbian Ground Squirrels (Manville 1959) and Richardson Ground Squirrels (*S. richardsonii*: G. Michener, personal communication). Arctic Ground Squirrels have been observed climbing trees for food, but only when artificially supplemented foods have been provided (K. Stuart-Smith, personal communication). Squirrels will feed on spruce buds and arboreal lichens, but only when other food sources are scarce (Lincoln 1972; Batzli and Sobaski 1980). It therefore seems unlikely that the primary reason for Arctic Ground Squirrels climbing trees in the Boreal Forest of the southwestern Yukon was to obtain food.

Our findings indicate that Arctic Ground Squirrels in the Boreal Forest will climb trees, deadfall, and stumps, and thus are not obligate ground-dwelling as previously suggested. The primary reason for climbing appears to be to gain access to temporary refuges and/or surveillance sites. This conclusion is based strictly on observational data, rather than experimental analysis. To more accurately determine if this is the prime reason(s) for climbing, predators should be simulated and the frequency of tree-climbing determined in simulated and unsimulated areas. To test the utility of these structures further, they could be added to unforested areas and their usage monitored (MacHutchon and Harestad 1990).

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# Do Female Sharp-tailed Grouse, *Tympanuchus phasianellus*, Copulate Only Once During a Breeding Season?

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Tsuji, Leonard J. S. 1996. Do female Sharp-tailed Grouse, *Tympanuchus phasianellus*, copulate only once during a breeding season? Canadian Field-Naturalist 110(3): 535–536.

Fluid mixtures taken from the reproductive tracts of eight female Sharp-tailed Grouse (*Tympanuchus phasianellus*), as they entered the lek, did not contain sperm or sperm fragments. Although not definitive, this study adds further support to the assumption that female Sharp-tailed Grouse typically copulate only once during a breeding season.

Key Words: Sharp-tailed Grouse, *Tympanuchus phasianellus*, oviduct, sperm, copulation.

It has been assumed in classically lekking grouse species that females typically copulate only once during a breeding season (except for renesting attempts). This perception was based initially on two types of field observations: (1) mating peaks at a lek closely correlated with hatching peaks of the young, 37 to 44 days later (Dalke et al. 1963; Svedarsky 1979); and (2) marked females observed copulating one day were not seen during subsequent display periods, at the same lek (Lumsden 1968; Kermott 1982). In recent studies by Hoglund et al. (1990) and Alatalo et al. (1991), female Black Grouse (*Tetrao tetrix*) were radio-marked and their copulatory behavior recorded. In the study by Alatalo et al. (1991), 79% of females (n=23) were known to have copulated only once at a given lek, while Hoglund et al. (1990) reported that 83% of the females (n=23) were known to have copulated only once at a given lek. Hoglund et al. (1990) also reported that females that copulated more than once were often individuals associated with a disturbed mating. This trend to remate after a disturbed mating was also observed for female Sharp-tailed Grouse (*Tympanuchus phasianellus*) (Gratson 1989). Thus, it appears that among classically lekking grouse species, females typically copulate only once during a breeding season, unless disturbed.

However, if one acknowledges that females can visit more than one lek during a breeding season (e.g. Kruijt et al. 1972), it becomes difficult to rule out multiple copulations because it would be difficult logistically, to observe all leks (during all morning and evening display periods) in a specified region for the entire breeding season, even if the females were marked. Another test of the assumption would be to collect females during the breeding season as they entered a lek, prior to copulation on that lek. Galliforms possess uterovaginal glands that store and constantly release sperm (Compton et al. 1978; Bakst 1981). Thus, female reproductive systems could be examined for the presence of sperm to establish whether or not prior copulation had occurred. If females typically copulate only once, approximately 80% of the female reproductive tracts should be without sperm.

Eight female Sharp-tailed Grouse were "harvested" by native Canadians near Fort Albany, Ontario, 52°15′N; 81°35′W, as the birds entered leks during the 1992-1994 breeding seasons. Reproductive tracts were processed using a technique modified from Bakst (1981). Oviducts were removed and flushed by syringe with 15% buffered formalin (after the distal end of the oviduct was ligated with 3–0 gut suture). Individual fluid mixtures (containing 15% buffered formalin and the flushed oviduct contents) were then emptied into separate test tubes, centrifuged, and the sediment examined in wet mount (for 5 minutes) under a microscope (x 100, x 250 objectives) for either sperm or sperm fragments. No fluid mixture contained sperm or sperm fragments.

Although the results do not provide definitive evidence, they add further support for the assumption that female Sharp-tailed Grouse mate only once during a breeding season.

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# Interactions of a White-winged Black Tern, *Chlidonias leucopterus*, with Arctic Terns, *Sterna paradisaea*, at Churchill, Manitoba

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Jehl, Joseph R., Jr. 1996. Interactions of a White-winged Black Tern, *Chlidonias lecopterus*, with Arctic Terns, *Sterna paradisaea*, at Churchill, Manitoba. Canadian Field-Naturalist 110(3): 536–537.

A White-winged Black Tern (*Chlidonias leucopterus*), a species of Eurasian provenance, appeared at Churchill, Manitoba, in June–July 1995, where it was persistently harassed by breeding Arctic Terns (*Sterna paradisaea*).

Key Words: White-winged Black Tern, *Chlidonias leucopterus*, Arctic Tern, *Sterna paradisaea*, agonistic behaviour.

On 24 June 1995, Arnet Sheppard of Ottawa, Ontario, videotaped an adult White-winged Black Tern (*Chlidonias leucopterus*) in alternate plumage at the mouth of the Churchill River, Manitoba. There are fewer than a dozen records for this temperate Eurasian species in Canada, and this was the first in central Canada and the subarctic. Sheppard's videotape and subsequent sightings and photographs confirmed his identification (R. Koes, personal communication).

During Sheppard's 5-minute observation period the tern's behavior was unremarkable. It flew along the shoreline, landed for a few minutes among a small flock of Arctic Terns (*Sterna paradisaea*) and Bonaparte's Gulls (*Larus philadelphia*), and then disappeared upriver toward the town of Churchill, after being attacked by a Parasitic Jaeger (*Stercorarius parasiticus*).

On 27 June, Jan van Gils and Irene Tieleman, researchers from The Netherlands, told me of a black tern whose characteristics fitted *C. leucepterus* that they had seen near the Arctic Tern colony at West Twin Lake, 26 km south-east of Churchill. That evening, Scott Yaeger and I visited the area for 15 minutes at dusk and photographed a single White-winged Black Tern (Figure 1) near a small, marshy island where 16 pairs of Arctic Terns were just starting to lay. It seemed to be exploiting a major emergence of dragonflies and would fly 1 km from the island, either over the lake or to the edge of the forest, catch a flying insect, then return to the colony, where it repeatedly attempted to land. On each approach the Arctic Terns immediately left their nests and aggressively chased it (Figure 2). Although the White-winged Black Tern managed to land twice, the harassment never ceased entirely and its time on the ground was momentary. By the next morning the tern — and the dragonflies — had disappeared.

Although many observers visited the colony in the following days, the White-winged Black Tern never reappeared there, and it was not rediscovered until 13 July, when T. and B. Holcombe of Tonbridge, Kent, England, saw it back on the Churchill River near the townsite. During their 45 minutes of observation it was "savagely pursued" by Arctic Terns, which on one occasion literally knocked it into the river. The aggression was confined to flight periods, and ceased when the tern landed among Bonaparte's Gulls and Arctic Terns; interestingly, it was always the last bird in the flock to land. The following day, B. Chartier also saw Arctic Terns harassing the tern in the same region; again, chasing ceased when the tern landed. The Holcombes' and Chartiers' observa-

FIGURE 1. White-winged Black Tern (*Chlidonias leucopterus*) at West Twin Lake, Churchill, Manitoba, 27 June 1995.

FIGURE 2. Two Arctic Terns (*Sterna paradisaea*, left) chasing a White-winged Black Tern (*Chlidonias leucopterus*) as it attempted to land in their colony.

tions were made within 0.5-1 km of an Arctic Tern colony of approximately 100 birds.

The far northern and usually coastal breeding range of the Arctic Tern is so different from that of the temperate and marsh-nesting White-winged Tern that the two species can come together only by accident. Thus, it will be difficult to learn whether the interactions described above represented a general response to intruders in the colony by Arctic Terns, which are generally considered to be very aggressive, or a specific response to the bold black-and-white flight pattern of the White-winged Tern. That the former might have been the case is suggested by a further observation from Churchill (Y. Zharikov, 12 June 1996) of Arctic Terns chasing a Black Tern (*Chlidonias niger*); the latter is a dark-bodied, but less boldly-marked, North American species that is closely related to the White-winged Tern. Farther south in the interior of North America, light-plumaged (e.g., Common [*S. hirundo*] and Forster's [*S. forsteri*]) terns nest amicably with Black Terns (W. Scharf, personal communication). Additional observations of interactions between light- and dark-bodied terns in the breeding season would be of interest.

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# Predation of an Eastern Chipmunk, *Tamias striatus*, by a Gray Squirrel, *Sciurus carolinensis*

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Faccio, Steven D. 1996. Predation of an Eastern Chipmunk, *Tamias striatus*, by a Gray Squirrel, *Sciurus carolinensis*. Canadian Field-Naturalist 110(3): 538.

I observed a Gray Squirrel (*Sciurus carolinensis*), attack and kill an Eastern Chipmunk (*Tamias striatus*) in Orange, Massachusetts. Published reports of Gray Squirrel predation upon other vertebrates consist only of bird eggs and nestlings.

Key Words: Gray Squirrel, *Sciurus carolinensis*, Eastern Chipmunk, *Tamias striatus*, predation, Massachusetts.

Animal foods are relatively uncommon in the diet of Gray Squirrels (*Sciurus carolinensis*) (Nichols 1958; Flyger and Gates 1990). Madsen (1964) indicated that squirrels frequently obtain calcium and other minerals from scavenged bones, shed deer antlers, and old turtle shells, while others report Gray Squirrels feeding on a variety of invertebrate prey (Hamilton 1943; Layne and Woolfenden 1958; DeGraaf and Rudis 1986). However, all published reports of Gray Squirrel predation on other vertebrates consisted of bird eggs and nestlings (Thoms 1922; Godin 1977). I report on a Gray Squirrel killing and apparently feeding on an Eastern Chipmunk (*Tamias striatus*).

My observation was made on the shore of Lake Mattawa, in the town of Orange, Worcester County, Massachusetts (ca. 42° 35'N, 72° 20'W). This manmade lake is surrounded by both seasonal and permanent homes within a mixed forest community dominated by White Pine (*Pinus strobus*), Eastern Hemlock (*Tsuga canadensis*), Red Oak (*Quercus rubra*), and Red Maple (*Acer rubrum*). The understory along the lakeshore is dominated by low Blueberries (*Vaccinium* spp.) and Black Huckleberry (*Gaylussacia baccata*) along with various ferns and herbs.

On 16 August 1993, attracted by a persistent screaming, I observed a Gray Squirrel attacking an Eastern Chipmunk. Clinging to the trunk of a White Pine approximately 1.5 m above the ground, the squirrel was grasping the screaming chipmunk by the back of the neck. The squirrel immediately carried the chipmunk up the tree to a leaf-nest approximately 10 m high where visual contact was lost. The chipmunk continued vocalizing for 5-10 seconds until an object fell from the nest. The squirrel immediately descended the tree and retrieved what appeared to be the chipmunk's head, and returned to the nest.

Since I did not witness the initial encounter I do not know if the squirrel actively pursued the chipmunk or preyed on it opportunistically. Other potential food sources were abundant at the time of the observation including blueberries, huckleberries, mushrooms, and a compost pile well-stocked with table scraps, indicating that food shortage was not a likely explaination for this predation. Although no direct evidence exists, it seems likely that the squirrel consumed the chipmunk based on the effort it expended to kill the animal, retrieve the head, and carry it to a nest.

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# Late Spring Arrival, Nesting, and Fall Departure by Common Nighthawks, *Chordeiles minor*, in Saskatchewan in 1995

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Poulin, Ray G., Paul A. Bradshaw, and Mark D. Graham. 1996. Late spring arrival, nesting, and fall departure by Common Nighthawks, *Chordeiles minor*, in Saskatchewan in 1995. Canadian Field-Naturalist 110(3): 539–540.

In 1995, Common Nighthawks (*Chordeiles minor*) were late arriving from their spring migration, late laying eggs and late migrating from Saskatchewan. Common Nighthawks were observed near Buffalo Pound Provincial Park, Saskatchewan, on and up to 17 October and two and possibly three individuals were observed in Regina on 19 October. To our knowledge, this is almost 3 weeks later than has ever been recorded at this latitude. Although the ambient temperature was near 0°C, these nighthawks were not in torpor.

Key Words: Common Nighthawk, *Chordeiles minor*, migration, Saskatchewan, torpor.

Common Nighthawks (*Chordeiles minor*) are the most widely distributed of the North American caprimulgids. Breeding occurs from the Northwest Territories and southern Yukon in the north to Mexico and Central America in the south, and from the Atlantic to the Pacific ocean across most of the continent. Although little is known about the location of their wintering grounds, they are thought to reside throughout much of South America, as far south as Uruguay (Bent 1940; Poulin et al. *in press*).

During spring migration, they arrive at the Canada/United States border (49°N, west of 99°W), during the last week of May and first week of June (Bent 1940; Rust 1947; Poulin et al. *in press*). In late summer, nighthawks gather in large flocks, sometimes greater than a thousand birds, to migrate south. They begin their migration from southern Canada/northern United States (49°N) by the third week of August and are generally thought to have left these areas completely by the second or third week of September (Campbell et al. 1990).

The timing of fall migration is likely dictated, at least partly, by the availability of food. Nighthawks feed on flying insects during crepuscular (dusk and dawn) hours. Cool temperatures, which prevail during spring and autumn, result in reduced numbers of flying insects for nighthawks to feed on and may influence the timing of migration.

One physiological adaptation employed by several species of caprimulgids to cope with unfavourable conditions is torpor (Reinertsen 1983). Torpor allows these birds to reduce metabolism as a means of conserving energy during unfavourable conditions. Inclement weather, including low ambient temperatures, extended periods of rain and/or strong winds are known to induce torpor in Common Poorwills (*Phalaenoptilus nuttallii*) (Brigham 1992; Kissner and Brigham 1993; Csada and Brigham 1994).

Lasiewski and Dawson (1964) induced torpor in captive Common Nighthawks by starving them. However, only one of four birds survived a drop in body temperature below 25°C. Firman et al. (1993) found no evidence of torpor by Common Nighthawks in the Okanagan Valley, British Columbia, even though the summer of 1990 was much colder and wetter than normal.

Brigham et al. (*in press*) provide limited evidence that Common Nighthawks are capable of entering torpor. One nighthawk in British Columbia and another in Alberta were found in an apparent torpid state, at ambient temperatures of 4°C and 5°C respectively. Brigham et al. did not determine if the birds were able to successfully re-warm and fly away.

At Coeur d'Alene, Idaho, the first observed southward flights of Common Nighthawks usually occur in August (66% of the time) but are often delayed until September (34% of the time)(Rust 1947). Between 1911 and 1946 the latest recorded sighting of a Common Nighthawk at Coeur d'Alene was 24 September (Rust 1947).

Bent (1940) reports the following late sighting dates for comparable locations: Okanagan Landing, British Columbia, 15 September; Tacoma, Washington, 11 September; Weston, Oregon, 9 September; Banff, Alberta, 17 September; Meridian, Idaho, 15 September; East-end, Saskatchewan, 15 September; Columbia Falls, Montana, 28 September; Great Falls, Montana, 6 October; Yellowstone Park, Wyoming, 15 September; Winnipeg, Manitoba, 19 September; Charlson, North Dakota, 22 September and a casual record of one bird at Allakaket, Alaska in either late September or early October.

The Okanagan Valley of British Columbia (49° 18'N, 119° 31'W) is a semi-arid region composed of a series of lakes linked by the Okanagan River. This area typically attracts large numbers of nighthawks (Cannings et al. 1987) and one might expect that nighthawks would remain later into the summer there than any other place in Canada. The latest recorded date of a nighthawk in that area was 30 September and the mean departure date was 18 September (Cannings et al. 1987).

Migration compels fledgling nighthawks to achieve maturation and independence by approximately the last week of August. Eggs are incubated for 17 to 20 days and young are able to fly well at 25 to 30 days of age but typically take 45 to 50 days to develop fully (Bent 1940). Therefore, in order for a chick to be capable of migration before the last day of August, eggs must be laid on or before 30 June, and must hatch on or before 16 July.

In previous years (1990-1994), Common Nighthawks were observed by approximately the first week of June in Cypress Hills Provincial Park, Saskatchewan (49° 34'N, 109° 53'W) (R. M. Brigham, personal communication). During the summer of 1995, the first sighting of a nighthawk in Cypress Hills was 28 May (R. G. Poulin), but not until 13 June was more than one nighthawk observed in an evening. This suggests that nighthawks were at least one week late arriving in 1995.

On 22 July a nest was found with a female incubating a single egg, this egg hatched on 6 August. Although the fate of this chick is unknown, given the developmental time requirements, this chick would not have been ready to migrate until at least 21 September, three weeks later than nighthawks normally leave Cypress Hills (R. M. Brigham, personal communication).

On and up to 17 October 1995, at approximately 11:00 each day, Common Nighthawks were observed (M. D. Graham) flying near Buffalo Pound Provincial Park, Saskatchewan (50° 40'N, 105° 30'W). These were individual birds, not the large migratory flocks normally observed at the end of August/beginning of September. The night-time minimum temperature on 17 October was 2.4°C (Environment Canada).

On 19 October, at least two, and possibly three Common Nighthawks were observed (P. A. Bradshaw) Regina, Saskatchewan (50° 25'N, 104° 39'W). At 07:00, one nighthawk was sitting alertly on a lamp post while one and possibly two other nighthawks flew near by. The overnight minimum on this date was -3.2°C and from this date onward overnight minimum temperatures did not rise above 0°C until the end of the winter season (Environment Canada). The months of September and October were normal in terms of average temperatures and precipitation (Environment Canada).

The observations of Common Nighthawks on 17 and 19 October are almost three weeks later than has ever been recorded at this latitude in western Canada, following the trend of the late spring migration, and late breeding in 1995. An important implication of the observations on the morning of 19 October is that these nighthawks were not in torpor during very cold temperatures (-3°C), where food availability was undoubtedly low. By comparison, Common Poorwills in the Okanagan, British Columbia used torpor consistently when night time temperatures fell below +1°C (Brigham 1992).

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# Horsehair Fungus, *Marasmius androsaceus*, Used as Nest Lining by Birds of the Subalpine Spruce-fir Community in the Northeastern United States

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McFarland, K. P., and C. C. Rimmer. 1996. Horsehair fungus, *Marasmius androsaceus*, used as nest lining by birds of the subalpine/spruce-fir community in the northeastern United States. Canadian Field-Naturalist 110(3): 541–543.

We examined 54 nests of 10 species on Mt. Mansfield and Mt. Equinox, Vermont and Plateau Mountain, New York in the subalpine Red Spruce (*Picea rubens*) – Balsam Fir (*Abies balsamea*) forest bird community in the northeastern United States in 1994 and 1995. Forty-six nexts (85%) were found to contain fine, black, hair-like strands as lining material. This material was defined as the rhizomorphs of Horsehair Fungis (*Marasmius androsaceus*) and represents the first documented use of this material by North American breeding bird species. We believe that many earlier descriptions of nest lining materials used by boreal and subalpine bird species may refer to mis-identified Horsehair Fungus. Our finding that 85% of nests in montane spruce-fir forests of the northeastern United States contained copius amounts of rhizomorphs suggests that this material is an integral component of nest construction in this habitat.

Key Words: Horse Hair Fungus, *Marasmius androsaceus*, nest material, birds, subalpine spruce-fir forest.

Several pieces of mushrooms in the genus *Marasmius* are known to produce copious amounts of thin, black and wiry rhizomorphs as a means of colonizing twigs and leaves (Redhead 1989; Seaver 1994; Singer 1986). The use of marasmioid rhizomorphs in the construction of bird nests has not been documented for any species breeding in North America. There are several repors of marasmioid rhizomorphs used as nesting material in China (Desjardin, personal communication *fide* Mu Zang), Cameroon (Desjardin, personal communication), and Brazil (Sick 1957). In Argentina, Golden-winged Cacique (*Cacius chrysopterus*) and Red-rumped Cacique (*Cacicus haemorrhous*) construct their nests principally of rhizomorphs from *Marasmius crinisequi* (Wright and Ferraro 1986). Hummingbirds collect the rhizomorphs of *Marasmius nigrobrunneus* in Ecuador for use in nest construction (Hedger 1990). In this paper we report the first documented use of Horsehair Fungus (*Marasmius androsaceus*) rhizomorphs as nest lining material by several North American breeding bird species.

During demographic studies of the subalpine Red Spruce (*Picea rubens*)-Balsam Fir (*Abies balsamea*) forest bird community in the northeastern United States in 1994 and 1995 we examined 54 nests of 10 species at three different sites: Mt. Mansfield and Mt. Equinox, Vermont and Plateau Mountain, New York (Table 1). Forty-six nests (85%) were found to contain fine, black, hair-like strands as lining material. While collecting microhabitat data around nest sites in 1994 we found large amounts of this material on live Balsam Fir trees and dead wood in the understory. These strands, which were found to have small basidiomes, were compared with those occurring in the nests and found to be identical. Close examination of the strands in the nests revealed that some also had small, dried basidiomes.

Samples of the hair-like structures and caps were sent to the North American *Marasmius* expert, Dennis Desjardin, Director of H. D. Thiers Herbarium, San Francisco State University, for identification. The hair-like structures were identified as rhizomorphs of the Horsehair Fungus (*Marasmius androsaceus*). The species is saprotrophic on needles, leaves and twigs and parasitic on some ericaceous plants in mesic and boggy situations (Gilliam 1976; MacDonald 1949; Redhead 1989). Horsehair Fungus is considered common in North America found across the boreal zone and south along the Rockies, Coastal Mountains and the Appalachians (Redhead 1989: Map Fig. 9). *Marasmius androsaceus* belongs to a group of closely related species, all of which produce numerous rhizomorphs. *Marasmius pallidocephalus* also occurs in the Northeast (Gilliam 1976; Redhead 1989) and could be used by birds in nest construction too (Desjardin, personal communication). Various species of the lichen genus *Alectoria* may resemble black, hair-like structures and could also be used.

Many published descriptions of avian nesting material that contain references to hair-like material or fine rootlets may actually represent the rhizomorphs that we identified. Wallace (1939) conducted life-history studies of Bicknell's Thrush (*Catharus bicknelli*) on Mt. Mansfield, Vermont, and thoroughly described the construction of the nest. However, he was unable to identify the inner lining of "fine, black rootlets," and stated, "they are unquestionably rootlets of some sort … resembling horsehair, but where the birds get them is a mystery." The Bicknell's Thrush, formerly a subspecies of the Gray-cheeked Thrush (*Catharus minimus*),

TABLE 1. Number of bird nests in the subalpine spruce-fir forest found to contain *Marasmius androsaceus* rhizomorphs used as nest lining.

| | Mt. Equinox, Vermont | | Plateau Mountain, New York | | Mt. Mansfield, Vermont | |
|---|---|---|---|---|---|---|
| | Horsehair Fungus in Nest Lining | | | | | |
| | Present | Absent | Present | Absent | Present | Absent |
| Yellow-bellied Flycatcher (*Empidonax flaviventris*) | – | – | – | – | 1 | 0 |
| Brown Creeper (*Certhia americana*) | 0 | 1 | – | – | – | – |
| Bicknell's Thrush (*Catharus bicknelli*) | – | – | – | – | 15 | 0 |
| Swainson's Thrush (*Catharus ustulatus*) | – | – | 2 | 0 | 2 | 0 |
| Magnolia Warbler (*Dendroica magnolia*) | 1 | 0 | – | – | – | |
| Yellow-rumped Warbler (*Dendroica coronata coronata*) | 2 | 0 | 1 | 0 | 4 | 0 |
| Blackpoll Warbler (*Dendroica striata*) | 1 | 0 | 1 | 0 | 16 | 0 |
| White-throated Sparrow (*Zonotrichia albicollis*) | 0 | 1 | – | – | 0 | 4 |
| Dark-eyed Junco (*Junco Hyemalis*) | – | – | – | – | 0 | 1 |
| Purple Finch (*Carpodacus purpureus*) | 0 | 1 | – | – | – | – |

"-" indicates no nests found at that site.

has recently been given full species status (Ouellet 1993; American Ornithologists' Union 1995). Bent (1949) reported several nest descriptions of *minimus*. In each case it appeared that the nest lining was composed predominantly of fine grasses, with one nest containing a few dried leaves and rootlets.

Bent (1953) described the Magnolia Warbler's (*Dendroica magnolia*) nest as "...lined invariably with fine black rootlets, which closely resemble horse-hairs. The lining of black rootlets is present in these and in all other nests of the Magnolia Warbler that I have seen, it seems to be characteristic of the species and will distinguish the nest from those of other warblers." However, we and several other authors have described the use of this material in large quantities by other warbler species.

Similarly, Bent (1953) reported that the Yellow-rumped Warbler (*Dendroica coronata coronata*) nest was {"...firmly interwoven with black horsehair, or perhaps moose hair, and finer rootlest..." Brewster (1882) described a nest of the Blackpoll Warbler (*Dentroica striata*) in the Magdalen Islands, Gulf of St. Lawrence, as having a lining "...of slender, black moss-stems (which curiously resemble horse hair)."

Bent (1942) related nest descriptions of Yellow-bellied Flycatcher (*Empidonax flaviventris*) from several people. In each case the lining material was described as a dark or black hair-like rootlet. Most notable was a description by Fendire, "...the black and shining rootlets of, apparently, ferns, closely resembling horsehair." Bent (1949) similarly presented Swainson's Thrush (*Catharus ustulatus*) nest descriptions, including one from Maine where the lining was described as containing "...black, thread-like parts of the roots of decayed cinnamon ferns." Finally, Bent (1968) noted that the nest lining of the Purple Finch (*Carodacus purpureus*) contained "...finer rootlets and horsehair."

We believe that many of these earlier descriptions of nest lining materials used by boreal and subalpine bird species referred to mis-identified Horsehair Fungus. Our finding that 85% of nests in montane spruce-fir forests of the northeastern United States contained copious amounts of rhizomorphs suggests that this material is an integral component of nest construction in this habitat.

A number of *Marasmius* species have been shown to produce antibiotic agents that inhibit the growth of *Staphylococcus* (Melin et al. 1947). However, the species, *Marasmius androsaceus*, was practically inactive upon *Staphylococcus* cultures (Melin et al. 1947). While it is possible that *Marasmius androsaceus* rhizomorphs may be an effective agent against nest pathogens and parasites of subalpine birds in the Northeast, this is not known. Alternatively, these rhizomorphs may simply provide the best of most easily obtainable material in this habitat for lining nests.

A voucher specimen of the fungus has been deposited in the H. D. Thiers Herbarium. Bicknell's Thrush, Swainson's Thrush, Blackpoll Warbler, and Yellow-rumped Warbler nests with rhizomorph lining are stored at the Vermont Institute of Natural Science.

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# News and Comment

## The Ottawa Field-Naturalists' Club 1995 Awards

The annual recognition ceremony for outstanding contributions toward Club goals in 1995 was held at The Ottawa Field-Naturalists' Club wine and cheese party on the evening of 26 April 1996 at the Unitarian Church Hall, 30 Cleary Street, Ottawa. Honorary membership remained at its maximum of 25 to the end of 1995. An account by Cendrine Huemer of this Soirée is given in *Trail & Landscape* 30(3): 89–91 July-September 1996. The following awards were presented:

### 1995 Member of the Year Award: Bob Bracken

The Member of the Year Award is given to the member judged to have contributed most to the Club in the previous year.

The recipient this year is Bob Bracken in recognition of his overall generosity and versatility and his specially active and productive 1995.

Bob has generously shared his knowledge and enthusiasm for the large variety of natural life represented in the flora and fauna of the National Capital Region with members of the Ottawa Field-Naturalists' Club for over fifteen years. He has led numerous club walks covering such diverse groups as ferns, butterflies, molluscs, fish, amphibians, and birds. He has served on the Rare Birds Sub-Committee, been a co-leader on eight spring birding trips to Presqu'ile, as well three to observe different aspects of natural history at Point Pelee in 1993, 1994, and 1995.

### 1995 Conservation Award to a Member: Jeff Harrison

The annual Ottawa Field-Naturalists' Club Conservation Award is given to a member in recognition of a recent outstanding contribution in the cause of conservation.

"Conservation" may be defined as "the wise use of natural resources", and while we often think of conservation as involving the protection of sensitive areas against inappropriate development, it can also involve the management of land for the benefit o wildlife. Accordingly, this year's Conservation Award is presented to Jeff Harrison for his work as Chairman of the Fletcher Wildlife Garden Committee and for his co-authorship, with his wife Victoria, of "The Urban Naturalist" column in *The Ottawa Citizen*.

The Fletcher Wildlife Garden was created for two main purposes: (1) to establish a wildlife oasis near the heart of Ottawa, and (2) to demonstrate to landowners how they can plant and arrange their property for the benefit of wildlife in the city. Through "The Urban Naturalist", Jeff, along with Victoria, have helped to nurture a love of wild, living things in readers of *The Citizen*, and have given many suggestions about things that individuals can do to help preserve nature in urban settings.

Environmentalists have often recommended that lovers of nature should "think globally and act locally" when fighting for the wise use of natural resources. Jeff Harrison has certainly taken this advice to heart.

### 1995 Conservation Award to a Non-member: Kit Chubb

Kit Chubb is one of those rare persons who take on a job and fulfil all requirements beyond all expectations. That job, in her own words, is "to improve the lot of wild birds".

After a career in nursing, Kit Chubb returned to her first love, the care and protection of wild creatures. In 1977, after seeing the desperate need for facilities for dealing with injured birds, she and her husband, Robin Chubb, established the Avian Care and Research Centre in Verona, Ontario, for all birds and especially raptors, herons, and loons.

The Centre now receives 400-500 birds a year with almost 200 species represented over the period of its existence. Not content to simply nurse and care and return birds to both health and home, Kit Chubb began a laborious process of observing and recording the thousands of birds treated over almost two decades. What makes her work truly outstanding is

her devotion to sharing her observations, case histories and wisdom with veterinarians, other researchers, and the public.

Her investigations into bird mortality have proved beyond doubt that lead shot was responsible for the poisoning of countless loons and waterfowl. Thanks to her efforts, great inroads are being made into banning lead shot entirely. Not to be deterred by the little time left with the care of 17 aviaries, she is also a talented writer and artist who uses her skills to rally others to the cause.

This award is given in recognition of her untiring efforts to restore the health of hundreds of owls, hawks, eagles and other raptors, both to Kit Chubb and to the Avian Care and Research Centre.

**1995 Anne Hanes Natural History Award: Marilyn Light**

The Anne Hanes Natural History Award is given in recognition of an outstanding contribution to our knowledge, understanding and appreciation of the natural history of the Ottawa Valley.

The 1995 Anne Hanes Natural History Award is presented to Marilyn Light for her eleven-year study of the population dynamics of orchids in Gatineau Park. In the process of research on over 1000 plants of *Epipactis helleborine* she has discovered and named one unique albino form of *Platanthera* and has determined factors involved in germinable seed yield in the Large Yellow Lady's Slipper, *Cypripedium calceolus*; the Lesser Purple Fringed Orchid, *Platanthera psycodes*, and the helleborine. She recently presented a paper on her work on orchid population biology to the Linnean Society of London. She has also directed an educational video for the Canadian Orchid Congress on the late Joseph Purdon and his conservation efforts with the Showy Ladyslippers on his property in Lanark County.

Due primarily to her interest in, and research of, Ottawa Valley flora she is becoming well known worldwide. In addition to her contributions in *Trail & Landscape*, she is a member of the Garden Writers of America and is a regular contributor to the Orchid Review of the Royal Horticultural Society in England, and Orchids Australia, a publication of the Australian Orchid Foundation.

BILL ARTHURS

Chairperson, and the Awards Committee of The Ottawa Field-Naturalists' Club

**1995 President's Prize: William D. (Dave) Smythe**

Each year the President selects an active member of the Club whose contribution merits special recognition. This year's selection is Dave Smythe, a relative newcomer to The Ottawa Field-Naturalists' Club, who has quickly established himself as a very useful member.

Dave and his wife Verna joined the Club in 1991. In 1992 they became members of the mailing team for *Trail & Landscape*. In 1993 Dave joined the Membership Committee and also became a member of Council. In 1994 he began reporting on the Annual Business Meeting for *Trail & Landscape*. The position of Recording Secretary came open in 1995 and Dave accepted my invitation to add this task to his list of duties. Today he continues to carry all of the responsibilities described above. We have yet to find a limit to Dave's capacity to serve the Club.

Candidates for the President's Prize must be accomplished and effective. Dave has impressed us in every task he has undertaken. He takes an independent approach in analyzing problem situations, carefully thinking through the implications, then offering advice if he thinks he has something to contribute His writing is concise, yet captures the essence of the subject. Could these qualities be related to his engineering degree and military training?

A key function of the Membership Committee is to maintain an up-to-date list of members, particularly for mailing *Trail & Landscape*. As anyone who has maintained a mailing list will testify, this is no simple task; accuracy and timing are critical. For the purpose the Club acquired a personal computer. Although he had no experience with personal computers, Dave undertook to maintain the official list on this machine. With some good coaching and a computer course, he now competently maintains the list, prints copies and labels, etc. References to computer hardware, software packages, and modems to link with other computers by telephone are creeping into Dave's conversations. The Recording Secretary's job is onerous in that one must understand the context of each topic discussed, record the essence of each meeting and get the minutes out well before the next meeting. These minutes become the focus for each meeting of the Council. He also is responsible for publishing the annual report and administrative details associated with official meetings. Dave makes the job appear easy. As a member of the Council, I have appreciated his thoughtful observations, when I served as President.

When not working for the Club, Dave is watching birds and here his characteristic competence again

surfaces. His ability to spot and identify birds makes him a welcome member on any birding outing. This interest in birding complements another interest: travel and foreign birds.

Before retiring from the Atomic Energy Control Board, Dave had travelled extensively in Europe. This experience introduced him to foreign cultures and gourmet foods, which have remained a continuing interest. Dave and Verna have two sons.

FRANK POPE

President [1995] of The Ottawa Field-Naturalists' Club

## Errata and Addenda to *A Life with Birds: Percy A. Taverner, Canadian Ornithologist, 1875-1947*

In "A Life with Birds: Percy A. Taverner, Canadian Ornithologist, 1875–1947" by John L. Cranmer-Byng *Canadian Field Naturalist* 110(1): 1-154, due to editorial oversight at late proof stage, the page numbers on the outside back cover contents list for the Selected bibliography, Appendices 1, 2, and 3, are in error and should read 197, 199, 201, and 202; also on page 1 the reference Charleston AOU meeting photograph in 1937 should be page 179 not 183. Similarly, a few errors, generally by one page, appear in the index. Flagrantly obvious editorial slips include the final entry to the list of illustrations on the inside back cover where Leonard "Street" should be Avenue, and in the photo caption on page 195 where "Hayes" should read Hoyes.

Readers wishing to correspond with John L. Cranmer-Byng should note that as of 22 July 1996 his address will be 40 Baif Boulevard, Apartment 303, Richmond Hill, Ontario, Canada L4C 5M9.

A comprehensive resume of bird study at the Geological Survey of Canada/National Museum of Canada/Canadian Museum of Nature, here particularly recommended for its sections on the post-Taverner period as a fitting epilogue to the Cranmer-Byng biography, has appeared as "Ornithology at Canada's National Museum" by Henri Ouellet, pages 303-322 *in* "Contributions to the History of North American Ornithology" *Edited by* William E. Davis, Jr., and Jerome A. Jackson. 1995. Memoirs of the Nuttall Ornithological Club, Number 12, vii + 501 pages, 108 figures. [Available from the Nuttall Ornithological Club, c/o Museum of Comparative Zoology, Harvard, University, Cambridge, Massachusetts, USA 02138.]

FRANCIS R. COOK

## *Rana-Saura*: Amphibian Follow-up Project – Atlas of Amphibians and Reptiles of Quebec

*Rana-Saura* Volume 3, number 1, June 1996, the newsletter of the *Atlas of Amphibians and Quebec* project, contains an updated summary of 1995 survey results. To date of publication 2049 observations collected by 277 volunteers had been added to the Quebec Data Bank with more than 100 from 1995 still to be added. A discussion of the most interesting new records and the relative abundance of observations of most observed least observed species is given.

Also available is The *Atlas of Amphibians and Reptiles of Quebec* (reviewed in *The Canadian Field-Naturalist* 109(4): 493, 1995) previously published in french, but, as of the end of June, available in English at $12 a copy plus postage and handling charges of $4.00 for orders up to $24.00, $6.00 for orders up to $120.00 and $8.00 for orders over $120.00 (charges in U.S. funds for U.S. orders). Specify if French or English edition desired. Order from:

St. Lawrence Valley Natural History Society
21 125 Chemin Ste.-Marie, Ste-Anne-de-Bellevue, Quebec
H9X 3L2 * Phone: 514-457-9449.

## *The Frog Monitor* and *DAPCAN IV Proceedings*

*The Frog Monitor* Volume 1, Number 1, is dated March 1996. This newsletter contains information on the monitoring project for Manitoba amphibians, and lists the names of 19 participants who have monitored for all three seasons of the project, and 17 who have monitored for two. Project growth is demonstrated by the 93 monitoring instruction kits sent out this past season, and the 124 new volunteers. A capsule survey of the results from the past three years gives which species are observed most frequently and some tentative conclusions on abundance trends in some. There is a brief outline of some do's and dont's of monitoring technique, a call for questions and a notice of a identification workshop held by the Manitoba Field Herpetologists 18 April 1996 at the Manitoba Museum.

Also available is *DAPCAN IV, the Fourth Annual Meeting of the Task Force on Declining Amphibian*

*Populations in Canada Proceedings* held at the Manitoba Museum of Man and Nature October 1-3, 1994 and cosponsored by the Manitoba Department of Natural Resources; Environment Canada, Canadian Wildlife Service, Prairie and Northern Region; and Ducks Unlimited's Institute for Wetland and Waterfowl Research. The proceedings include reports internationally (Ron Heyer) and regionally for eastern Canada (Donald F. McAlpine) and western Canada (Stan A. Orchard) as well an assessment by the Historical Database Committee (Wayne F. Weller, Michael J. Oldham, Frederick W. Schueler, and Martyn E. Obbard. A keynote address by Henry W. Wilbur discusses Amphibian Population Biology. Research Reports are presented by David M. Green (Fowler's Toad)[abstract only], Ronald J. Brooks and Leonard J. Shirose (Bull, Green and Mink frogs), Stephen J. Hecnar (Regional dynamics of amphibian pond communities in southwestern Ontario), Christine Bishop and Karen E. Pettit (Monitoring in Ontario), Peter Taylor (diurnal and seasonal calling patterns of some Manitoba species), Joel Bonin (climatic and landscape changes vs. population declines in Quebec), Joel Bonin, Martin Ouellet, Jean Rodrigue, Jean-Luc Des Granges, Tim R. Sharpel, and Leslie A. Lowcock (measuring health of frogs in agricultural habitats subject to pesticides in Quebec) [abstract only], Kathryn A. Kelsey (effects of logging on stream-breeding amphibian populations in Washington) [abstract only], Jan J. Roth and Reid Westland (ultraviolet and hydrothermal radiation -northwestern Colorado and Kenora, Ontario), Martin Ouellet, Joel Bonin, Jean Rodrique, and Jean-Luc Des Granges (disease investigation, pathological findings and impact on amphibian populations in southern Quebec), Michael Lepage, Rehaume Courtois, Claude Daigle, and Sylvie Daigle (abundance of anurans in Quebec based on volunteer surveys of mating calls). Two posters were presented; one by Christine Bishop, John Struger, and Karen E. Pettit (environmental fate and effects of organophosporus insecticides on amphibians in Ontario) the other by James Duncan, Errol Bredin, Gavin Hanke, Ron Larche, William Preston, Dough Ross, Carol Scott, and Ken Stewart (estimated status of Manitoba amphibians based on criteria used by the Nature Conservancy's Conservation Data Centre Network. The publication concludes with an account of a workshop on methods and objectives of sampling amphibian populations by Ronald J. Brooks, the discussion and business meeting as recorded by Carolyn Seburn, and a list of registrants with addresses.

WILLIAM B. PRESTON

Manitoba Museum of Man and Nature, 190 Rupert Avenue, Winnipeg, Manitoba R3B 0N2. *Phone (204) 956-2830 *Fax (204) 942-3679 *e-mail: bpreston@mbnet.mb.ca.

## *Canadian Association of Herpetologists Bulletin*

The *Canadian Association of Herpetologists Bulletin* volume 10, number 1, Spring 1996 is 10 pages and contains notes on "Space Herpetology" by Richard Wassersug and the latest report on "herpetological happenings" from Redpath Museum by Production Editor David M. Green. Also included is a report on the Annual Meeting of the Society for Northwestern Vertebrate Biology by Sheri Watson and on the Fifth International Congress of Vertebrate Morphology by J. M. V. Rayner. Miscellany includes notes on Volunteer Amphibian Monitoring Programs - updates and on Information Bulletins, both by Editor Anthony Russell, and notice that "COSEWIC designates the Wood Turtle a Vulnerable Species in Canada by David M. Green. Abstracts of three 1996 herpetological theses, all from the University of Guelph, are given: Heather Leigh Passmore (M.Sc.) Geographic variation in life-history in four populations of *Chelydra serpentina* Linneaus; Jacqueline Danielle Litzgus (M.Sc.) Life-history and demography of a northern population of spotted turtles, *Clemmys guttata*; Megan Leslie Harris (M.Sc.) A characterization of adult and premetamorphic leopard frogs (*Rana pipiens*) and green frogs (*Rana clamitans*) in wetland influenced by agricultural activities. (Supervisor of the first two, Ronald J. Brooks; of the third, James P. Bogart).

Membership in the Canadian Association of Herpetologists is $10.00 (regular) and $5.00 (student). Application should be made to:

PATRICK T. GREGORY

Treasurer, Canadian Association of Herpetologists, Department of Biology, University of Victoria, P.O. Box 3020, Victoria, British Columbia V8W 3N5

## Notice of the 118th Annual Business Meeting of The Ottawa Field-Naturalists' Club

The 118th Annual Business Meeting of the Ottawa Field-Naturalists' Club will be held in the auditorium of the Victoria Memorial Museum Building, McLeod and Metcalfe streets, Ottawa, on Tuesday 14 January 1997 at 19:30 h.

DAVE SMYTHE
Recording Secretary

## Call for Nominations: The Ottawa Field-Naturalists' Club 1997 Council

Candidates for Council may be nominated by any member of The Ottawa Field-Naturalists' Club. Nominations require the signature of the nominator and a statement of willingness to serve in the position for which nominated by the nominee. Some relevant background information on the nominee should also be provided. Deadline for nominations is 15 November 1996.

FRANK POPE

Chair, Nominating Committee

## Call for Nominations: The Ottawa Field-Naturalists' Club 1996 Awards

Nominations are requested from members of The Ottawa Field-Naturalists' Club for the following: Honorary Membership, Member of the Year, George McGee Service Award Citation, Conservation, and the Anne Hanes Natural History Award. Descriptions of these awards appeared in *The Canadian Field-Naturalist* 96(3): 367 (1982). The Service Award was renamed the George McGee Service Award for 1993 presentations [see *The Canadian Field-Naturalist* 108(2): 243-244 (1994)]. With the exception of nominations for Honorary Member, all nominees must be Club members in good standing. Deadline for nominations is 1 December 1996.

BILL ARTHURS

Chair, Awards Committee

## Book-Review Editor's Report for *The Canadian Field-Naturalist* Volume 109 (1995)

Time was something missing from the new titles and reviews in Volume 109. The book-review editor managed to spend about half of his in Africa and thus was not very good at keeping up with all my correspondence and new books. My reviewers have stepped in to save me. I pass my thanks for the patience and understanding they have. I must also echo my annual plea to keep contacting me when a book of interest is published or listed in our New Titles. I have over 100 faithful reviewers and many specialist or occasional participants. We count on you all, but the time to keep up with each one of you is just not there.

The Book-review statistics for Volume 109 are summarized below. The number of New Titles listed was much smaller than usual. Due to special issues and my own absence, there were only New Titles in the second and fourth issues of 1995. Also due to my lack of time, there were fewer requests for reviews or for books to review. The reviewers and publishers both came through to keep the numbers of books available and the number of reviews published up to our usual numbers.

Book Review Statistics for Volume 109:

| Issue | 1 | 2 | 3 | 4 | Total |
|---|---|---|---|---|---|
| Reviews Requested | 8 | 11 | 14 | 0 | 33 |
| Books to Reviewer | 9 | 20 | 13 | 22 | 64 |
| Reviews Completed | 0 | 58 | 17 | 10 | 85 |
| Reviews Published | 16 | 7 | 2 | 43 | 68 |
| Books Requested | 17 | 6 | 7 | 0 | 30 |
| Books Recieved | 6 | 42 | 8 | 27 | 83 |
| New Titles Listed | 0 | 66 | 0 | 120 | 186 |

I am always looking for new reviewers and hoping some of the past ones will come back. If you are interested please contact me. Books listed in the New Titles as available will be sent to the first person requesting them. New, appropriate titles can be requested from the publishers and will usually be supplied. Book reviews should be 1 to 2 pages, double-spaced in length and informative to *The Canadian Field-Naturalist* readers. Reviewers are expected to submit reviews within three months of receiving the book. Reviewers get to keep the complimentary book supplied.

WILSON EEDY

Book-review Editor, R.R. 1, Moffat, Ontario L0P 1J0
Fax: 1-905-333-0798
e-mail: edith@wat.hookup.net (home) or
we@geomatics.com (work)

### *Recovery:* An Endangered Species Newsletter

This is an eight-page news and background leaflet issued by the Canadian Wildlife Service, Environment Canada dated "Spring 1996" but with no volume or issue number included, and no actual address in the issue itself. However, my copy came with a covering note from Linda Maltby, Chief, Endangered Species Conservation Division, Canadian Wildlife Service, Environment Canada, Ottawa, Ontario K1A 0H3, dated 10 July 1996. Copies are presumably available through that office. This issue includes an article on attempts to start a new wintering grounds for Whooping Crane: "Flying down to ... New Mexico?" (Brian Johns). [The only current wild self-sustaining population is given as 157 birds and it winters in marshes along the Texas coast, a vulnerable habitat due to the volume of petroleum and chemical products carried shied through adjoining waters.] "Working for endangered species: a provincial perspective" (Arnold H. Boer, New Brunswick Fish and Wildlife Branch); "A redhorse of a different colour" (Alain Branchaud and Rejean Fortin) [The Copper Redhorse, restricted to one or more rivers in southwestern Quebec.]; Wildlife on the Hill: Parliamentary committee considers conservation of endangered species" (Jim Foley); Commentary: Endangered species legislation and land claims: challenge or opportunity?" (John Bailey); Protecting critical habitat for blue racers on Pelee Island (Ben Porchuk and Ron Brooks); an announcement of the RENEW report on the swift fox; a retirement tribute to Bruce Johnson; and notice of the move of Dale Hjertaas to an unspecified position with the Saskatchewan government behind the "front" lines of conservation".

FRANCIS R. COOK

### *The Boreal Dip Net*

Volume 1, Number 2, Summer-Fall 1996, 4 pages, is the newsletter of the Working Group on Amphibian and Reptile Conservation in Canada [WGARCC] which also includes the IUCN/SSC Task Force on Declining Amphibian Populations in Canada. Articles featured are "Amphibians and the changing atmosphere" (Stan Orchard), "Atmospheric change: themes for discussion" (Andrew Blaustein); "What does climate change mean for North American Amphibians?" (Michael Lannoo); "UV-B and the ecology of northern lakes"; "76th Annual Meeting of the Society for NW Vertebrate Zoology - A report" (Larry Powell); "Manitoba amphibian monitoring: 'Wildly successful'" ; New Book: *Okoboji Wetlands: A Lesson in Natural History* by Michael J. Lannoo, University of Iowa Press, Iowa City. This newsletter bears no address but presumably can be obtained from Stan A. Orchard, National Co-ordinator for Canada, WGARCC, Royal British Columbia Museum, Victoria, British Columbia V8V 1X4.

FRANCIS R. COOK

### Great Lakes Fact Sheet: Amphibians and Reptiles in Great Lakes Wetlands: Threats and Conservation

This attractive 12-page leaflet, distributed in early July, is published by Environment Canada and authored by Leonard Shirose, Christine Bishop, and Andree Gendron. It focuses on the current threats and conservation initiatives for amphibians and reptiles in Great Lakes wetlands and with colour photographs, diagrams, charts, maps, and graphs. It leads off with the example of the Spotted Salamander, then defines a wetland and discusses its value (habitat for wildlife, water purification, food control, recreational activities). It continues with threats (including biological: e.g. Common Carp, Purple Loosestrife); individual species of amphibians and reptiles (Blanchard's Cricket Frog, Eastern Spiny Softshell Turtle, Snapping Turtle, Mudpuppy) and "What You Can Do" ( Backyard Surveys, Amphibian Road Call Counts, Marsh Monitoring of the Great Lakes, Amphibian and Reptile Survey). It gives examples of wetland rehabilitation projects in progress (Black Ash Creek pond creation, Cootes Paradise, Oshawa Second Marsh). The newsletter concludes with an outline of the Metro Toronto Zoo's "Adopt-A-Pond" project, Addresses for those wishing to get further involved and a short list of Further Reading.

Other fact sheets in this series include: Contaminants in Herring Gull eggs from the Great Lakes, Bringing the Bald Eagle back to Lake Erie, The Fall and Rise of Osprey Populations in the Great Lakes Basis, The Rise of the Double-Crested Cormorant on the Great Lakes: Winning the War against contaminants.

This fact sheet series is ideal for school classes and naturalists groups, is straightforward, readable, eye-catching. This and other information on wetlands and habitat loss in the Great Lakes basin are available from: Environment Canada, 4905 Dufferin Street, Downsview, Ontario M3H 5T4. Also visit Environment Canada's Greenlane on the World Wide Web: http://www.cciw.ca/glimr/intro.html.

FRANCIS R. COOK

## Joint Annual Meeting Working Group on Amphibian and Reptile Conservation in Canada and Task Force on Declining Amphibians and Populations in Canada (DAPCAN)

This joint meeting was a continuation of the highly successful DAPCAN initive as the 6th Annual meeting for that group, combined with the new Working Group on Amphibian and Reptile Conservation which contains DAPCAN but has a broader perspective by including reptiles. It was held 5-7 October 1996 at the University of Calgary, Calgary, Alberta, and was co-sponsored by Environment Canada, Canadian Wildlife Service, Burlington, Ontario. As well as annual regional reports the program included a symposium on conservation of reptile populations in Canada and a workshop on herpetological atlassing. The keynote address this year was given by Dr. R. Bruce Bury, U.S. National Biological Service, Corvallis, Oregon "Amphibian Conservation in Western North America: Progress, Pitfalls and Perspectives".

Further information may be obtained from Stan A. Orchard, Chairman, Working Group on Amphibian and Reptile Conservation in Canada, 1745 Bank Street, Victoria, British Columbia V8R 4V7 * phone/fax 604-595-7556 * e-mail: sorchard@islandnet.com

## *Global Biodiversity*

Volume 6, Number 1, Summer 1996, 48 pages, of this Canadian Museum of Nature journal which bills itself as "An International Forum on the Variety of Life on Earth ... research, conservation and wise use" is a special marine issue. An initial editorial by Michael L. Smith, Center for Marine Conservation, Washington, D. C., is starkly titled "The sea is changing, and it matters." Following are six papers, each briefly placed in context by an introductory paragraph by Editor D. E. McAllister, on a variety of marine habitats of high concern: "Exploring deep coral reefs: How much biodiversity are we missing?" (Richard L. Pyle, Bishop Museum, Hawaii): "Marine reserves: Necessary tools for biodiversity conservation?" (Jack Sobel, Center for Marine Conservation, Washington, D.C.); "Lessons from deep, hot places" (Verena Tunnicliffe, University of Victoria, British Columbia); "The global policy outlook for marine biodiversity conservation" (John Waugh, IUCN-US, Washington, D.C.); "Conservation of marine biodiversity in the Caribbean: Regional challenges" (Jose A. Ottenwalder, UN Development Program, Dominican Republic); and "Cuba: An island's approach to marine biodiversity" (Diana Ibarzabal and Juan P. Garcia, Institute of Oceanography, Havana, Cuba). This issue's "portrait of biodiversity" is the sponge *Hippospongia lachne*. The issue concludes with News (Biodiversity, Cyberdiversity, Biodiversity meetings) and Reviews (Book and periodical niche). The last item in the latter, the book *Biological Systematics: The state of the Art* [by A. Minelli, published by Chapman and Hall, 1993] reviewed by Alison M. Murray and Brian W. Coad, Canadian Museum of Nature, concludes with a pithily upbeat epilogue, painfully fitting for all aspects of biodiversity study and conservation but particularly so for the fundamental organizer of this knowledge, pure systematics:

> "Problems of funding and lack of resources (especially people) plague all areas of systematics and institutions throughout the world. The state of the art may appear to be in a shambles, but progress, while slow, is being made ...."

Persons wishing to subscribe, place advertisements, or support the publication financially should contact Global Biodiversity Business Manager Dawn Arnold, or Subscription Manager Susan Swan, Canadian Museum of Nature, P. O. Box 3433, Station D, Ottawa, Ontario, Canada K0G 1R0; * Phone (613) 993-5908; * Fax (613) 990-0318; * e-mail <darnold@mus-nature.ca>.

FRANCIS R. COOK

## Adopt a Black Rat Snake Program, Charleston Lake Provincial Park, Ontario

The Black Rat Snake, *Elaphe obsoleta*, is not only one of Canada's largest snakes (attaining at least seven feet total length here and perhaps as long as nine feet in the United States, at least in the past), but also one of the more restricted in range in this country. In Canada, it occurs in southwestern Ontario, where it is now rare and patchily distributed in surviving islands of woodland, primarily in Norfolk County, and in a disjunct area in eastern Ontario in the "Frontenac Axis", the rocky region lying largely south of Smith Falls to east of Kingston. Within this it can be locally relatively abundant. It has been intensively studied by Dr. Patrick Weatherhead of Carleton University, Ottawa, and his students at the Queen's University Biological Station at Chaffeys Locks since the early 1980s through mark-release and radio transmitter implant monitoring. Additional, later, studies have been on other protected populations in the region at St. Lawrence Islands National Park, Murphys Point Provincial Park, and Charleston Lake Provincial Park. In the latter park, the Adopt-a-Black-Rat-

Snake program has been initiated by the support group, the Friends of Charleston Lake Park. $15 sponsors an identification microchip implant for a Black Rat Snake. Donors are sent their snake's data when it is marked and will be notified each year it is recaptured. As well, they receive an annual report on the project as a whole, whether or not their snake has been found that year. Initiated in 1995, the program has been received enthusiastically by park visitors, local residents, and schools. To the end of June, 1996, 34 snakes had been implanted and six recaptured. Monitoring data will not only generate data on individual ranges, activity areas, growth, mortality rates, egglaying areas, overwintering den use patterns, and many other details of snake life and habitat use, but also, eventually, failitate detection of any changes in these over extended time. Accumulated data from many snakes can be used to develop estimates of population size and density as well as for further public education programs.

For more information contact Mike Ogilvie, Senior Natural Heritage Education Leader, Charleston Lake Provincial Park, RR 4, Lansdowne, Ontario K0E 1L0.

FRANCIS R. COOK

## *Sea Wind:* Bulletin of Ocean Voice International

Volume 10, Number 2, April-June 1996 of *Sea Wind* contains information on ongoing and upcoming environmental initiatives pertaining to the conservation of the world's oceans under the headings: the Ocean Voice International Update, The Scoop on Shrimp, Independent World Commission on the Oceans, 8th International Coral Reef Symposium in Panama, and World Survey on Status of Coral Reef Fishes and Habitat. It also includes a "Book Nook", and sections of longer "Sea News" and shorter "Short Sea News" items, as well as an "On the Net" section of computer addresses for information of Ocean Voice and contacts of interest. Subscription and information on back issues and other publications can be obtained from:

Ocean Voice International, Inc., P.O. box 37026, 3332 McCarthy Road, Ottawa, Ontario, Canada K1V 0W0 * Telephone: (613) 264-8986 * Fax (613) 264-9204 * e-mail: mcall@superaje.com

## *Froglog:* IUCN/SSC Declining Amphibians Populations Task Force

Number 18, August 1996, of *Froglog* contains items on the status of *Rana latastei* in Croatia and Slovenia, Amphibians Declines in Puerto Rico, The Vanishing Amphibians Exhibit (Smithsonian Institution Travelling Exhibition Service), Amphibians and the Changing Atmosphere (a report on the workshop held in Corvalis, Oregon, 24 February 1996), Re-survey of Yosemite Area Shows Collapse of Anuran Fauna (results of a 1992 survey of 38 sites compared with that of one from 1915 through 1919), Mixed Fortunes of the Frog Fauna of New Zealand, The Effect of UV-radiation on Alpine Newts, Third Meeting of The Central Region Working Group (United States: Iowa, Missouri, Illinois, Indiana, and Ohio), Publications of Interest (14 papers and articles appearing in 1995 and 1996) and New DAPTF International Coordinator (John Wilkinson replaces John Baker).

Froglog is available on request from John Wilkinson, Department of Biology, The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom ** Telephone: 01908 (44 1908 if ex-UK) 652274 ** Fax: 01908 (44 1908 if ex-UK) 654167 ** e-mail: DAPTF@open.ac.uk. Froglog can also be found on the World Wide Web at the following URL: http://acsinfo.open.ac.uk/info/newsletters/FROGLOG.html

*Errata:* In *The Canadian Field-Naturalist* 110(2): 335 notice of *Froglog* Numbers 15, 16, and 17, Stephen Corn was NOT, nor intended to be read as the writer of the notice itself but was singled out as a convenient North American contact for further information. Further, he was not, as stated there, Task Force Chair, but was Monitoring Protocols Chair (see *Froglog* number 15, page 4, upper right column) at the time, but now is Rocky Mountain Working Group Co-Chair. My apology to both Stephen Corn and to readers for these editorial lapsi and the inconvenience they have caused. The correct contact for Task Force information is J. Wilkinson. (address above).

FRANCIS R. COOK

## Newsletter: Ontario Natural Heritage Information Centre

Volume 3, Number 1, Spring 1996 published by the Ontario Ministry of Natural Resources, is 12 pages and contains items on: Interesting Plant Records from Northwestern Ontario, NHIC field-work documents New Mollusc Species for Ontario, Freshwater Mussel Surveys, Ontario's Lost Plants, Rare Communities of Ontario: Perched Prairie Fens, and sections on Stewardship (Natural Areas Manual Files, Natural Area Database, International Alvar Conservation Initiative, Great Lakes Biomonitoring Project, Looking ahead: Delhi to Simcoe Prairies, Gap analysis for the conservation of Ontario rarest elements), NHIC Information Products (list of 21 publications since the last Newsletter authored by NHIC staff), Systems (Database Imports, Software Development, Focus on ... Rob Parry) and News and Notes (NIHC's Future Direction, NIHC on the Move, Survey of Southern Ontario Sand Barrens for *Tachysphex pechumani*, NHIC-Sir Sandford Fleming College GIS Project, NHIC Logo, Results of Annual COSEWIC Meeting, Publications, Thanks to Don Smith, NHIC Staff List). The NHIC Newsletter can be obtained from the Natural Heritage Information Centre, P. O. Box 7000, Peterborough, Ontario, Canada K9J 8M5 * Fax (705) 745-5575

## *Picoides:* Bulletin of the Society of Canadian Ornithologists

Volume 9, Number 1, June 1996, contains — A word from the President: New Pathways, New Horizons (David Nettleship) — S.C.O. Annual Meeting 1996, University of New Brunswick, Fredericton, N. B., 23-26 August 1996 — Canadian Landbird Conservation Program (Henri Ouellet) — S.C.O. Column ("Publish or Perish": an Alternative interpretation: A. J. Erskine: an plea to publish data while it still can be coherently retrieved, "the data now in files may be in landfills soon. Publish or they will perish.") — S.C.O. Student Awards (1995 and 1996) — Recent Literature (*Ornithology in Ontario* reviewed by A. J. Erskine) — In Press (publications in ornithology within the past six months listed by Canadian centres) — Announcements and News Items — Editor's Musings (A. J. Erskine). *Picoides* is published by The Society of Canadian Ornithologists, c/o Canadian Wildlife Service, Atlantic Region, P. O. Box 1590, Sackville, New Brunswick, Canada E0A 3C0. Membership in the Canadian Society of Ornithologists is $10.00 and can be applied for from the Membership Secretary, Dr. Nancy Flood, Department of Biological Sciences, University College of the Cariboo, 900 McGill Road (Box 3010), Kamloops, British Columbia V3C 5N3.

## Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act (WAPPRIITA)

On 6 June 1996, Canada formally announced proclamation of the Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act. The Act had received royal assent on 17 December 1992 but certain "implementation issues" had to be addressed through regulations for which the Act required agreement by provincial and territorial wildlife ministers. This was received in December 1995, and the Act entered into force 14 May 1996 after the Special Committee of Cabinet gave final approval to the first set of regulations.

WAPPRITA attempts to provide a new legislative tool to promote tighter controls on illegal trade of wildlife and plants and to prohibit trafficking in endangered species. Regulations under it will help prevent the illegal possession, trade or commercial sale of restricted wildlife items. Offenders will be subject to fines of up to $150,000 for individuals, and up to $300,000 for corporations, not only for the illegal importation of endangered species, but also for the possession of products made from these species. WAPPRITA compliments existing provincial and territorial legislation and improves Canada's compliance with international agreements, such as the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES). WAPPRIITA also gives national support to provincial and territorial management programs as it will no longer be possible to break the law in one province and escape prosecution by leaving the jurisdiction. Both provincial and foreign permits will be recognized, eliminating duplication.

The text of "An act respecting the protection of certain species of wild animals and plants and the regulation of international and interprovincial trade in those species" is published in The Statutes of Canada 1992, Chapter 52, Third Session, Thirty-fourth Parliament 40-41 Elizabeth II, 1991-92, Bill C-42, pages 1–15.

The full text of the "Regulations" for the act are published as *Statutory Instruments 1996 SOR/96-263 in Canada Gazette* Part II, 130 (11): 1758–1808; Ottawa, Wednesday, May 29, 1996.

A simplified users guide is published as *Your*

*Guide to WAPPRIITA: Information on Canada's law to control trade in wild animals and plants.* Environment Canada, Ottawa, 24 pages.

Copies of the User's Guide, The Act and Regulations with the schedules, the Act and Regulations without the schedules, CITES Control List (either the full list or sections on only mammals, birds, reptiles and amphibians, plants or fish and invertebrates), and Regulatory Impact Analysis Statement are available from:
Publications, Canadian Wildlife Service, Ottawa, Ontario K1A 0H3 * Telephone: (819) 997-1095 * Fax: (819) 953-6283

Information about the Act and Regulations is also available at Environment Canada's home page on the World Wide Web. The address is http://www.ec.gc.ca

## Conservation Groups in Canada

"A short field guide to conservation groups — Chapter 1: Canada's National Groups" by Cendrine Huemer appears in *Trail & Landscape* [The Ottawa Field-Naturalists' Club's regional journal] 30(3): 104-113, July-September 1996. Seventeen groups and five coalitions are listed with a capsule summary of their activities and address and phone number (with only three omissions). The Society of Canadian Ornithologists is included but the Canadian Association of Herpetologists is omitted as are other professional societies such as the Canadian Society of Zoologists and the Entomological Society of Canada.

FRANCIS R. COOK

## SAMPA III

The Third International Conference on the Science and Management of Protected Areas (SAMPA III) will be held in Calgary from 12 to 16 May 1997. Conference participants will consider the linkages between protected areas and the management of whole ecosystems in both terrestrial and marine environments. Topic areas are:

- Partnerships Linking Protected Areas and Working Landscapes
- Linking Mountain Landscape Corridors
- Science and Values in Decision-making
- First Nations Approaches to Protected Areas
- Role of Biosphere Reserves in Linking Protected Areas and Working Landscapes
- Linking Ecological Monitoring in Working Landscapes and Protected Areas
- Greater Ecosystem Concepts
- Cross Boundary Issues: Air, Water, Wildlife
- Education and the Development of Public Awareness and Support
- Defining and Measuring Biodiversity
- Biodiversity in Protected Areas
- Biodiversity in Working Landscapes
- Maintaining Ecological Integrity and Biodiversity
- Managing Natural Resources While Protecting Biodiversity
- Applications in Landscape Ecology

The Call for Papers is out, and abstracts for papers, posters, workshops, panels or exhibits are due 17 January 1997. Organizers coach authors to write the abstract to spark the readers' interest, and provide whatever background is required to understand how you reached your conclusions and why they are important. Single-spaced, typewritten abstracts must fit within a box 17 × 9 cm (6.5 × 3.5 in), including title of the paper and name of the author(s). Contact the Conference Secretariat for more information.

Twice — in Halifax in 1994 and in Wolfville in 1991 — the conference served as a forum for presenting and discussing current perspectives on the role of science in managing protected areas and the role of protected areas in the conduct, support and promotion of scientific research. A special marine symposium will again be part of the conference, and pre- and post-conference tours will highlight marine and terrestrial protected areas. In addition, you will soon be able to visit the SAMPA III Webpage — look for a link to us from the Banff or George Wright Society websites.

*For a link to SAMPA III check: http://www.worldweb.com/ParksCanada-Banff or http://www.portup.com/~gws/home.html. All communications should be sent to Patricia Benson, SAMPA III Conference Secretariat, #552, 220 4th Avenue SE, Calgary, Alberta, Canada T2G 4X3. Tel: (402) 292-4519, fax: (403) 292-4404, e-mail: sampa3@pch.gc.ca.*

# A Tribute To Claude Eugene Garton, 1907–1996

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Hebden, Joan. 1996. A tribute to Claude Eugene Garton, 1907–1996. Canadian Field-Naturalist 110(3): 554–557.

> To see the world in a grain of sand
> And heaven in a wild flower
> Hold infinity in the palm of your hand
> And eternity in an hour.
>
> William Blake

After several years of confinement due to illness, Claude E. Garton was released by death on 1 January 1996. His memorial service held a week later was attended by a wide cross-section of the people of Thunder Bay and beyond, who gathered to share memories and rejoice in the long life of a remarkable man.

Claude was born on 26 February 1907, on a dairy farm near Aylmer, Ontario, the son of Joseph E. Garton of London, Ontario, and Edna M. Hoffman of Detroit. His three sisters, Mary, Dorothy, and Joan, all predeceased him. He is lovingly remembered by his daughter, Lorraine; his grandchildren, Ben and Sarah Martin; Lorraine's husband, Gordon Morton; and Sarah and Ben's father, Bill Martin; Bill's sister Amy Hubert; and nephews Wayne Crawford, Eddie Joe Rothgarber and Bob Rothgarber and their families. He was especially close to his niece, Barbara Boyd, and her children, Bethany and Gordon, who live here in Thunder Bay.

Growing up on a farm under the migration flyway, and near Lake Erie, may well have influenced the pattern his life was to follow — one of passionate interest in the natural world. He used to say he began botanizing as a small child. After attending high school in Aylmer and St. Thomas, he went on to graduate from London Normal School in 1926, then taught for two years at S.S. #5 Southwold, Essex County. But, young and ambitious, or curious about the northern part of the province, he accepted a teaching position with the Port Arthur Board of Education, working at St. James Street, Pine Street, and Current River schools, and was soon promoted to principalship, at that time a position requiring considerable dignity and authority. He must have liked Current River school very much, for he stayed there for most of his teaching career, leaving from 1942-1946 only to serve in the Canadian Army in the Personnel Division.

He married a Port Arthur girl, Evelyn MacGoldrick, bought a house near Current River school, and became an enthusiastic member of the community in which he taught. It was not a fashionable part of the city, working class for the most part, but Claude was no snob. He liked the area close to the edge of the city with the "bush" looming on the hills nearby.

Like many other ambitious young teachers at the Lakehead, Claude took extra-mural courses from Queen's University and attended summer school there, earning a degree in Chemistry and Biology in 1942. His intense interest in taxonomy dates from those studies, although he and his friend Lloyd Slichter had started serious collecting as early as 1933.

Claude was part of a lively group of friends, mostly teachers, who enjoyed the out-doors both in summer and in winter. They built a small ski jump on one of the golf courses. With more enthusiasm than skill, Claude tried that jump and knocked himself out! But he returned the following week and mastered it. One winter when the freeze-up came well before the snow, he was part of a group which skated the fourteen miles over the harbour ice to the Welcome Islands and back, the same day. Any time free from summer school or teaching he spent roaming the wild country beyond the city limits, collecting plants in season. By now his circle of friends extended beyond fellow teachers to others concerned with birds and plants. Led by Col. L. S. Dear, an early local naturalist who collected nests, legally, of course, he and several other like-minded people founded the Thunder Bay Field Naturalists in 1933. Except for the war years when energy was needed elsewhere, that club continued to flourish, largely because of the dedication of people like Claude. In those days, conservation was rarely heard of, and birding was regarded with suspicion.

When Col. Dear became frail, a triumvirate of friendly rivals carried on. Dr. A. E. Allen, a pathologist; Keith Denis, a civil servant: and Claude kept the club going, holding most of the offices in turn, until it became well established and attracted members who caught their enthusiasm. Claude long outlived his two old friends, and continued his active membership until he could no longer get out to meetings. During those active years he found time to start a Junior Naturalists Club, which, after inevitable ups and downs, is still flourishing under the sponsorship of the Thunder Bay Field Naturalists.

Claude E. Garton in the field, Thunder Bay region, Ontario, in retirement.

The field trips that were a part of the club's activities were very popular, and those Claude led always attracted a crowd despite his impatience with latecomers (they were left), and the pace he set. What exciting adventures he led us into! A cedar bog, mosquito infested of course, introduced us to the exquisite Fairy Slipper Orchid, *Calypso bulbosa.* A long, breathless climb up a heavily forested hill was rewarded by the sight of a magnificent clump of Braun's Holly fern, *Polystichum braunii.* A steep, slithery scramble down a gravelly river bank brought us to a pretty waterfall where we actually walked behind the sparkling curtain of water! Claude's purpose was to show us a rare little fern growing on the wet rocks, but the experience was too exciting for the name of that plant to register – to his annoyance! Then there was the long bush whack into Cavern Lake, where we crawled deep into a strange, lenticular cave to count bats. Those who came on time, and kept up the pace learned a great deal about birds and plants, and the inter-relationships among rocks, soil, climate and life forms. Those who chould not keep up, like two teenagers found sitting on a rock weeping, were quietly rescued by more experienced Claude-followers, and brought back to the cars.

Evelyn, Claude's wife, came on some of these outings. A thoughtful woman, she was prepared for emergencies. On one outing to the Slate River to examine the strange concretions that formed in its sedimentary banks, one of the youngsters fell in and got thoroughly soaked. It was Evelyn who produced an extra pair of dry trousers, Claude's of course, and the boy soon rejoined the hike having to roll up the cuffs only once. Sadly, Evelyn died in 1956, leaving Claude and their eleven-year old daughter, Lorraine, to manage on their own. Despite their heart-break, they did just that. He was a good plain cook, although his jams and jellies made from wild fruits and berries were gourmet fare. Always well organized, he kept house, worked in their garden and brought up a fine daughter. She credits her father's early feminist views with encouraging her to pursue her own studies with a sure confidence in her own abilities. Ironically, her academic success surpassed her father's, in earned degrees at least. But then he really did earn his honorary doctorate.

Claude continued to teach and fulfill his duties as principal at Current River until 1966, when he retired from the school system and devoted himself full time to his first love, botany. He had been collecting for the Department of Agriculture and for the

Canadian Museum of Nature, both in Ottawa, as well as building a personal collection that finally outgrew his space at home. So, he gave the 14 000 specimens to Lakehead University where it formed the nucleus of a growing collection. He became curator of the university's herbarium for a number of years, serving also as an informal counsellor and mentor to many students who soon discovered him to be a source of help and encouragement. The university authorities named the herbarium after him, and began to make use of his obvious abilities as a teacher. He even gave a course in botany to a small class in Geraldton, a little town on Hwy. 11 about 180 miles east of Thunder Bay. Perhaps he remembered his own years of extra mural study, and enjoyed giving the personal help that isolated students appreciate. His circle of friends now included university people, both staff and students and he moved easily in both groups.

Claude held membership in a variety of societies and organizations: American Bryological Society, American Institute of Biological Sciences, Canadian Botanical Association, Ottawa Field-Naturalists' Club, Claude Garton Home and School Association, Federation of Ontario Naturalists (Former Director), New England Botanical Club, Northwestern Ontario Conservation Association, Ontario Public School Men Teachers' Federation, Port Arthur Horticultural Society (Former Director), Thunder Bay Field Naturalists (Former President), Thunder Bay Fish & Game Association, and the Torrey Botanical Club.

During the 1940s and 1950s, Claude had spent some of his summers as Park Naturalist both at Sibley (now Sleeping Giant) and Quetico provincial parks. He identified plants and birds, led nature walks, and generally stirred up interest in both those fascinating places. He started a little museum at Sibley, despite the lack of adequate facilities, to display some of the park's special habitats. As always he made new friends through this work and through exchanges with other collectors. The correspondence he kept includes letters from far and wide – Northwest Territories, many states in the United States, and even Australia. These letters usually refer to plants, or of course, but they invariably include references to good times in the field, often expressing thanks for hospitality given and invitations to visit. Claude did visit some of these correspondents, but only on this continent.

His new work at Lakehead University must have brought him joy. The students loved him, one class made up a long song about their trials in the field-the refrain of which ran "Just ask Claude." And he began to look the part. Freed from the obligation of being and looking like a school principal, he gradually adopted the casual dress of his students, wearing tee shirts in summer and plaid shirts in winter along with jeans or work pants and boots. He stopped shaving, whether to save time or to make a statement, who knows? Soon the rather dapper teacher figure became the white bearded "character" we knew for his last thirty years. He did keep a suit, but rarely wore it, preferring to add a tie to his plaid shirt for formal occasions. The two rarely blended. I think he enjoyed his new persona especially when he began to get fatter. He loved to tell a story about walking along a hallway in the university one January, and seeing a little girl playing with a new doll just outside of an open classroom door. She was probably the child of a student who could not afford a babysitter. Claude stopped to admire the new doll, and asked the child who had given it to her. She looked up at the kindly, white-bearded, rotund old fellow and replied with a big smile, "Don't you remember? You did."

During the early years of his retirement he continued to collect, extending his territory eastwards to include the shores and islands of Lake Nipigon, and along the coast line of Lake Superior and into Pukaskwa Park, finding many arctic and alpine species that had survived in those cold zones. In 1971 he became involved in an unusual project near Wawa, a small community on Hwy. 17 about halfway between the Lakehead and the Sault. Because of its location, hitch-hikers often became stranded there, and a camp was set up near an archaeological dig run by Professor Ken Dawson of Lakehead University. The hikers were expected to help with the work in return for food and shelter. Claude, who was collecting in the area, soon had them helping him and inevitably becoming interested in the plant life around them. Of course, he and Ken knew each other from their work at the university. In some ways Northern Ontario is like a small town.

In spite of all these activities Claude continued to be active with the Thunder Bay Field Naturalists, not leading field trips but arousing support for his many concerns with habitat preservation. Members listened to his appeals, wrote letters, attended Open Houses, and made formal presentations to support such projects as protecting the Bur Oaks, *Quercus macrocarpa*, at Stanley, a village west of the city; saving the remaining marshes along the shore within the city limits; and preserving an old growth stand of White Pine, *Pinus Strobus* L., at Greenwood Lake west of Thunder Bay. His enthusiasm and obvious concern inspired the younger members who carried on the struggle when age finally began to slow the old leader down.

Unlike many hard workers, Claude lived to be publicly recognized for his efforts and even to see some of his projects succeed. The school he had worked in and for so long was renamed the Claude E. Garton School and its Home and School Association made him an honorary life member. After his memorial service, the social hour was held at that school with

lunch served by the Home and School members – a very thoughtful choice. Of course the Thunder Bay Field Naturalists had long since made him an honorary life member. After naming their herbarium after him, Lakehead University made him first an Honorary Professor of Biology, then an Honorary Doctor of Science, recognizing that he had been too busy doing science to have time for the usual paper work needed to gain degrees. Perhaps that is why he published so little; his quiet retirement devoted to writing turned out to be as active as the rest of his life had been. The Federation of Ontario Naturalists awarded him its Conservation Trophy at their annual meeting held in Thunder Bay in 1978, and even the city named him a "Citizen of Exceptional Achievement" in 1979. And the Ottawa Field Naturalists' Club made him an honorary member in 1985. He saw "his" collection in the herbarium grow rapidly and exchanges with institutions as far away as Europe became common place. Over forty first records for Ontario were accepted and show an achievement in the study of botany that is unmatched anywhere in the north. His old friends in the Thunder Bay Field Naturalists held a dinner to fête him, and he thoroughly enjoyed the good natured "roast" that followed, as a number of old friends told stories of experiences they had shared with him.

Perhaps more important than knowing he was appreciated, he lived to see his projects being carried on. The Bur Oaks still stand, sheltering one of the few patches of Poison Ivy, *Rhus toxicodentron* L. that grow up here. There are two wetland parks along the city's shoreline. Both attract many casual visitors as well as bird watchers and children learning about marsh life. It is good to have an uncultivated bit of shoreline where one can contemplate the Sleeping Giant and Welcome Islands with no hydro lines or industrial buildings in the way. A handsome Visitors' Centre now houses a natural history museum at Sleeping Giant Provincial Park, and Claude was able to help cut the ribbon at its opening. Even the pines at Greenwood Lake are protected, at least for the present. Dr. W. Carmean, now retired from active teaching at Lakehead University, has continued the fight to save that ancient stand.

But perhaps the best reward for a long busy life was the steady stream of visitors who called during the last few years when he could not get out easily. Very old friends like Clark MacDonald recalled with him their early days as teachers here in what must have seemed an alien land. His niece, Barbara Boyd, stood in for Lorraine, who lives in southern Ontario, and with her two children made sure he was well cared for.

By looking at one of his sheets in the herbarium, one can sense some of the character of the man who prepared it. The plant, elegantly arranged on the paper, still retains much of its colour for it was dried and pressed with patient care. The card at the bottom of the sheet, in neat lettering, identifies it completely and states very precisely exactly where and when it was collected. This is true even of the specimens that are not showy; the grasses, lichens, and mosses are all conscientiously given their due.

But Claude had a side to his character that many of us never suspected. At his memorial service, after the usual tributes and hymns, Barbara's two children, Bethany and Gordon, each read a favourite poem of theirs from a collection their "uncle" had copied out in long hand in an obviously much handled note book. The young people had shared those poems with Claude. The busy, active outdoorsman so deeply concerned with the natural world that most of us had known so long, was also a lover of poetry.

## Acknowledgments

I appreciate help given by Clark MacDonald; Dr. W. Carmean; Erika North, present Curator of the Claude E. Garton Herbarium; Dr. J. H. Soper, and Dr. Susan Bryan.

## Publications

**Dale, H. M.,** and **C. E. Garton.** 1984. The aquatic macrophyte vegetation of an isolated island adjacent to Lake Nipigon, Ontario: A comparative study after a fifty-six year interval. Canadian Field-Naturalist 98: 444–450.

**Garton, Claude E.** 1984. Checklist – Vascular Plants of Thunder Bay District – revised to 1984. Published by Thunder Bay Field Naturalists. 42 pages.

**Garton, C. E.** 1987. Ice age relics, arctic and alpine plants. Nature Northwest [Thunder Bay Naturalists Club newlsetter] 41(1): 2–7.

**Garton, Claude E.,** and **Joan Crowe.** 1993. Checklist – Vascular Plants of Thunder Bay District – prepared by Lake University, based on Garton 1984, revised to 1993. Published by Thunder Bay Field Naturalists. 51 pages.

**Soper, J. H., C. E. Garton,** and **D. R. Given.** 1989. Flora of the North Shore of Lake Superior. National Museum of Natural Science, Syllogens Number 63. 61 pages.

Manuscript reports included a *Botanical Inventory of Pukaskwa National Park* 1974–1977 (used as source for a booklet produced by the friends of Pukaskwa Park. Also other manuscript reports were made for the Ontario Ministry of Natural Resources on Sibleys, Caven Lake, and Lake Nipigon.

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# Book Reviews

## Zoology

### Shells of Atlantic and Gulf Coasts and the West Indies

By R. Tucker Abbott and Percy A. Morris. 1995. Peterson Field Guide Series, Houghton Mifflin Company, Boston. 350 pp., illus. U.S. $26.95.

For the naturalist interested in collecting and identifying sea shells found along the Atlantic coast of Canada, United States as well as the West Indies, the new book by Abbott and Morris represents an essential tool. It is the most complete one-volume guide on marine molluscs yet available for those regions of the Atlantic. This fourth edition comes some 20 years after the last published edition (1973) and almost 50 years since the first edition was published (1947). Faithful to the fomat of the Peterson Field Guides series, this excellent pocket book contains brief yet accurate and informative text and is supported by good quality pictures. The focus of this new edition is on shallow-water species found along the Eastern coasts of North America and the West Indies, especially from Labrador to Texas. The name, description, as well as distribution of approximately 800 molluscs are included in this book.

This fourth edition contains a number of significant changes. As mentioned by the authors, many deep-sea species that were featured in the third edition – and which were out of reach for most amateur or professional malacologists – have been excluded. Also new to this fourth edition is the inclusion of 115 new fine drawings and 74 new beautiful color plates (in the third edition most shells were represented by black-and-white plates). As a professional malacologist I find these color plates very useful as they give the reader a clearer picture of the shell of each species. Furthermore, the authors have also insisted in adding the scientific authority to each species name given (author, date), which is, as mentioned by Abbott, useful as it helps to trace original species descriptions and in recognizing homonyms. As in the previous edition, molluscs in this Peterson book are arranged by Classes, Families, Genera, and Species. The nomenclature, however, has been revised according to the extensive and well-accepted classification found in the review work by Kay and Boss (1989) *A Classification of the Living Mollusca,* edited by Abbott and Boss.

The new book by Abbott and Morris also contains a clear and welcome conservation tone in its introduction, which should encourage naturalists sensitive to the problem of overcollecting by amateur and professional malacologists around the world. In addition, the book includes a well-described listing of tips for proper collecting of shells, and tips on how to prepare live shells after field collecting, including techniques for easy removal of animal tissue from the shells using hot water baths or microwaves; in short, many good tips for the naturalist or keen amateur shell collector. I strongly recommend the new fourth edition *Shells of the Atlantic and Gulf Coasts and the West Indies* by Abbott and Morris to every naturalist interested in molluscs.

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### The Summer Atlas of North American Birds

By J. Price, S. Droege, and A. Price. 1995. Academic Press, San Diego. x + 364 pp. U.S. $29.95.

The abundance of plants and animals varies geographically. This can be observed by hiking up a mountain or travelling long distances. Although it may seem trivial, this critical fact is not presently reflected on distribution maps available in standard field guides. Instead, species' ranges are mapped by connecting extreme known localities and filling the range with one colour, or a few colours in the case of migratory species.

Recently, the availability of continent-wide databases and the development of spatial statistics have made it possible to illustrate not only the extent of a species' range but also the variation in abundance that exists within range boundaries. For example, Terry Root has produced relative abundance maps in her *Atlas of Wintering North American Birds* using data from the Christimas Bird Count. In the *Summer Atlas of North American Birds,* Jeff Price and his collaborators now present relative abundance maps for the summer distribution of 450 bird species and identifiable forms using the North American Breeding Bird Survey (BBS) database. The authors insist that they have produced a *summer* atlas rather than a *breeding* atlas since the BBS methodology is aimed at collecting abundance data, not breeding evidence.

The authors state that the original goal of this book was to "help birders find birds". Each colour-coded map illustrates the relative abundance of a species throughout the range it occupied during the 1985-1991 period. The four abundance classes used are illustrated with contrasting colours and bounded by contour lines obtained from kriging (a spatial interpolation technique). In addition, the authors provide the location of the BBS routes where the highest abundance was recorded for 531 species and identifiable forms (including 81 species whose maps are not provided). The book also includes a table documenting population trends for the 1966-1993 period (based on BBS data) as part of a chapter on conservation issues.

Maps of relative abundance are a major improvement compared to previously available maps of bird distribution. The authors carefully selected the BBS routes to be included in the data set and they adjusted their criterion for mapping the edge of the distributions (0.1 to 0.5 birds per route per year) to account for differences in the detectability of species. No text or drawings were included along with the map of each species. This was a wise decision since the targeted audience ("serious" birders) does not need to see drawings of the bird species, and a text could do little more than describe patterns obvious on the maps.

My main criticism pertains to the decision of the authors to crop the maps eastward and northward. Readers from Newfoundland, Prince Edward Island, and Cape Breton will be dismayed to see that their islands are not included in this atlas. Maps only extend northward to a line stretching from the top of Vancouver Island across the middle of the prairie provinces, to the level of Anticosti Island, on the north shore to the St. Lawrence River. The restriction of maps to portions of the continent densely surveyed by the BBS was probably aimed at maximizing the accuracy of the interpolation technique used to produce the maps. However, a better compromise would have been to include portions of the continent less well covered by BBS routes and to delimit with a line the areas beyond which contour lines are less accurate.

In spite of these criticisms, this book is a gold mine of information, not only for birders, but also for "macroecologists" and biogeographers interested in analyzing the variation in species abundance over large spatial scales.

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## A Photographic Guide to North American Raptors

By Brian K. Wheeler and William S. Clark. 1995. Academic Press, London and New York. 198pp., illus.

Contrary to my previous bias that a painting (e.g., by Roger Tory Peterson) can show the diagnostic features of a bird better than most colour photographs, the 377 superb photographs in this book (46 of Red-tailed Hawks alone, including two striking albinos!), have forced me to change my mind.

Raptors perhaps have more confusing variants in plumage than any other group of birds; the permutations and combinations at times confound even the most experienced observer. Inconsistencies in plumage have forced Wheeler and Clark, appropriately, to make frequent use of hedging words such as "usually" and "often". After fifty years in the field, one can still encounter a raptor in a plumage never seen before, and be quite unsure as to species identification. General field guides are forced for reasons of space to omit many raptor plumage presentations.

If one already owns a copy of the previous Clark and Wheeler book, *A Field Guide to [the] Hawks [of] North America,* or of *Hawks in Flight,* by Pete Dunne, David Sibley, and Clay Sutton, does one require this book in addition? The answer in my opinion is a resounding YES. This book offers, in addition to the photographs, many helpful "pearls" or diagnostic clues. Following extensive coverage of every species of raptor, there are fourteen additional chapters dealing with specific raptor identification problems, including perched juvenile large falcons (gyrs have relatively small heads and massive chests); perched juvenile buteos; perched dark-phase buteos; and differentiation between a dark gyrfalcon and a dark peregrine, and between a dark Rough-legged and a Harlan's Red-tailed Hawk. Some long-standing identification marks are not as specific as we were once told – a raptor with a dark bib may not be Swainson's; we are shown three other possibilities. Similarly, a dark belly-band is not specific for the Red-tailed Hawk, as other species can have one and some redtails do not. A pale-headed buteo can be one of four species.

This first edition is not yet perfect. When eponyms, Krider's, Fuertes' and Harlan's, are used freely within the Red-tailed Hawk, even though Krider's is a color phase and not a subspecies, it seems insupportable to substitute "prairie" for the long-accepted and well-differentiated "Richardson's" subspecies of merlin; this action could lead one to suspect an anti-British bias and a snub to the Empire's finest surgeon-naturalist in all history.

The Osprey flight photos are a bit disappointing. Figure RT19 shows the underwing of a juvenile Redtail when the text describes the upper wing. Twice, statements in the text are not shown in adjacent photos; in Identification Problem 3, a cross-ref-

erence to photo RT26, and in problem 2, a cross-reference to photo RS12, would have been useful. A few statements in the text (e.g., the gray blob across the center of the tail in the female Golden Eagle) are not convincingly shown in the photographs. In Problem 3, there is a different shape of the pale panel on the undersides of the primaries; those of the Red-shouldered Hawk are definitely crescent-shaped, but only one of the four other species has a panel that even approximates the geometrical definition of a trapezoid; perhaps a diagram here would have helped the reader.

These are minor quibbles. I recommend that you buy two copies, one for home and one for your vehile. The points made by Wheeler and Clark are worth referring to again and again: they emphasize, for example, the value of noting relative leg length and relative length of tail versus wing in a perched hawk. Pointers are given to help in differentiating between sexes and ages of some species. If this volume receives the widespread and careful use it deserves, many fewer misidentifications of raptors should find their way into the literature in future.

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## Flammulated, Boreal, and Great Gray Owls in the United States: A Technical Conservation Assessment

Edited by Gregory D. Hayward and Jon Verner. 1994. General Technical Report RM-253. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 214 pp. 3 maps.

This publicaion brings together much new material on three little-known species of owls. There is a separate, large map for each species, depicting, with great accuracy, known sightings within the United States. A table for each species lists presence or absence in each of the 89 National Forests in the United States: the Flammulated Owl is breeding in 24, present in another 30, and suspected in 17 forests; corresponding figures for the Boreal are 11, 30, and 3; for the Great Gray, 13, 29, and 6. How are these species threatened by habitat loss or degradation?

The Flammulated Owl is the most southerly of the three in distribution, although its range extends into extreme southern British Columbia. It is migratory (though no distant band recovery has yet been obtained). Spring arrival dates are in late April and early May. It hunts exclusively at night, eating nocturnal arthropods. Pairs shown high site fidelity. In some forests, it is the commonest bird of prey, with 10 owls per 40 hectares in the White Mountains of Arizona; elsewhere there is rarely more than one owl per 40 hectars. It lays a uniformly small clutch of 2 to 4 eggs. Adult survival is probably more critical than annual nest success. Maximum longevity to date is 8 years, 1 month. In order to survive this little owl "simulates greater size and strength by its bravado and ventriloquial voice, at the same time behaving elusively and inconspicuously by night and day."

The Boreal Owl extends much farther south in the Rocky Mountains than had been appreciated. In the 1970s, new roads allowed access; winter recreation in high mountain lands increased, allowing detection of their small and semi-isolated populations. mature and older forest in the spruce-fir zone provides the highest quality habitat for this obligate cavity nester; breeding populations are not found more than 100 m below the spruce-fir zone. Annual survival is estimated at 45 to 80% for adults, but only 20 to 50% for juveniles. Winter and summer ranges are both more than 1000 hectares, and up to 3390 ha. Boreal Owls hunt primarily after dark, and usually attack prey only within 10 m of their hunting perch. They eat small mammals (*Microtus, Clethrionomys,* and *Peromyscus*), but add the Northern Pocket Gopher, *Thomomys talpoides,* to their diet in Idaho. They breed in the first year after hatching. Adult annual survival of 25 radio-marked owls in Idaho was 46%. Their main predator is the pine marten (*Martes* spp.). Because this owl uses already patchy high-elevation forests, global warming could affect it adversely, by driving it to higher elevations.

The Great Gray Owl can be the commonest owl in Black Spruce-Tamarack forest wetlands. In peak vole years, they reach 1.88 pairs per km$^2$ in northern Minnesota and adjacent southern Manitoba. They lay their eggs in old goshawk and raven nests, or on broken-topped snags. Mean date of first egg laid is 5 April in Manitoba but 5 May in Idaho and Wyoming. Egg laying is delayed in years of heavy snow cover. In Manitoba and Minnesota, 81% of nests fledged an average of 2.8 young, but 91% of 32 radio-marked fledglings died before they were one year old. Goshawks and Great Horned Owls are common predators, especially when hares and grouse are scarce. Female owls abandon their young after 3 to 6 weeks, but males feed the young until they are three months old. When vole populations crash, the owls may move up to 700 km, the adult females moving earlier and farther. A female banded as an adult was recaptured 13 years later.

This up-to-date compendium is highly recommended to anyone interested in these forest owls. New information from James R. Duncan of Winnipeg will be of special interest to readers of this journal.

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BOTANY

## Rare Vascular Plants in the Canadian Arctic

By C. L. McJannet, G. W. Argus, S. Edlund and J. Cayouette. 1993. Syllogeus 72, Canadian Museum of Nature, Ottawa. 79 pp., illus. Free.

## Rare Vascular Plants in the Northwest Territories

By C. L. McJannet, G. W. Argus and W. J. Cody. 1995. Syllogeus 73, Canadian Museum of Nature, Ottawa. 104 pp., illus. Free.

The recently-retired President of the Canadian Museum of Nature once described the systematic classification of Canadian birds, mammals, plants, amphibians and reptiles as *old-fashioned science* and stated that the Museum's fundamental modern mandate was to be *an interactive family entertainment device*. Long after such smug drivel has been forgotten, however, documents like the two considered here will remain testaments to the *real* fundamentally important contribution of this much-beleaguered institution… the systematic collection and authoritative analysis of Canadian biodiversity data.

These are the latest (final?) elements in a series of fourteen provincial and territorial rare vascular plant treatments going back to 1977. Each has quickly become the "bible" for determining rare plant status in their respective jurisdictions. Various governmental and private initiatives have expanded into a virtual industry of investigation and management of regionally and nationally rare species across Canada. In addition to the protection of innumerable rare plant populations, the Rare Plants of Canada Program data presented in these reports have led to the protection of hundreds of sites and the incidental protection of thousands of "non-target" significant organisms.

Both reports are utilitarian, staple-bound publications that are produced with clear, readable type and adequate mapping. Each considers those taxa determined to have a small population within their respective region, *viz,* known from few records or from a very restricted range. Each taxon receives a brief statement on nomenclature, major literature references, phytogeographic affinity, and habitat. The valuable Nature Conservancy status (Global Rank) is noted for most of the taxa described in the Northwest Territories treatment though not with those in the Canadian Arctic study (why not?). Most importantly, both treatments include small but workable range maps for each taxon based on a comprehensive review of authoritatively examined specimen records in their respective regions. A discussion of the systems of protected areas and the implications of on-going aboriginal land claims for rare plant protection are worthwhile additions to the Northwest Territories study.

As one would expect, peripheral species more widespread in other regions make up the bulk of the 206 Northwest Territories and 236 Canadian Arctic taxa treated. Fully a third of these are from the Boreal Forest region. Very few are nationally rare (only 39 in the Northwest Territories) and even fewer (18) are endemic to either area.

The Canadian Arctic study is virtually a subset of the Northwest Territories treatment. It includes much of the political territory of the Northwest Territories as well as the relatively small arctic portions of Yukon, Manitoba, Ontario, Quebec, and Newfoundland/Labrador - all floras covered by previous rare plant treatments. While it is useful to have an examination of this natural unit (as it would for the Boreal Forest, the Prairie Parkland, etc.), a standalone volume seems somewhat extravagant for data which for the most part are also published elsewhere. There may have been considerable gains in economy and understanding by including this assessment in a concise appendix of the Northwest Territories treatment instead.

These two studies constitute a solid, comprehensive "where we're at" statement for the investigation and management of the rare flora of northernmost Canada. The series of which they form a part is a fine tribute to the work of recently retired George Argus who was the heart and soul of the Museum's Rare Plants of Canada program. Congratulations are due, too, to the Ottawa Field-Naturalists for their financial support for the publication of the Northwest Territories report.

*Old-fashioned science* indeed; this is cutting edge stuff. What can be more critical to the advancement of Canadian biological sciences, after all, than the maintenance of our native biodiversity?

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## Aquatic and Wetland Vascular Plants of the Northern Great Plains

By Gary E. Larson. 1993. General Technical Report RM-238. U.S. Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station, Fort Collins, Colorado. 681 pp., illus.

The present book deals with over 500 aquatic and wetland vascular plants that occur in the northern Great Plains of North Dakota, South Dakota, Nebraska, Montana, and Wyoming. Though Canada is not covered, most of the aquatic and wetland plants of the prairies of southern Alberta, Saskatchewan, and Manitoba are included.

This reviewer grew up with Muenscher's 1944 *Aquatic plants of the United States* and with Fassett's 1957 *A manual of aquatic plants*. Though of considerable help, these books are rather complex as they include species from all of the United States. Those in the northern Great plains will find the present book especially helpful as it simplifies things by dealing only with the species of this region.

The book has a workable key to Families. This is followed by good family descriptions and helpful keys to genera and species. Each species has an accompanying description, comment on ecology and distribution, a distribution dot map on a county basis, and often a black-and-white line drawing or color photograph.

On the negative side, the book contains much empty space; the maps are rather crude and do not show vegetational zones; the illustrations lack descriptive legends and are not original; and there is no spine title. One may also wonder why the author has included some species, such as *Solidago gigantea* and *Lilium philadelphicum,* as wetland plants.

This treatise will be a valuable addition to the bookshelf of anyone involved with the identification of aquatic and wetland vascular plants in central North America.

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## Le symbiose mycorhizienne: États des connaissances

Edited by J. A. Fortin, C. Charest, and Y. Piché. 1995. Orbis Publishing, Frelighsburg, Québec. viii + 195 pp. $24.95.

During the last 30 years Québec achieved international stature in mycorrhizal research, largely due to the leadership of one man, J. André Fortin. This book records the proceedings of a colloquium on mycorrhizal symbiosis hosted by Dr. Fortin at the Institute for Research on Plant Biology of the University of Montréal, in conjunction with the congress of the French Canadian Association for the Advancement of Sciences in 1994.

The book contains ten chapters contributed by 17 authors who are predominantly francophones, and who either work in Québec or have strong professional ties with the Québec group. What they offer is a mixed fare of new and not so new; some of the work (most notably that of L. Simon) has been reported elsewhere, in English.

Vesicular-arbuscular mycorrhizal fungi (VAM) are the ubiquitous symbionts of plants, including agricultural crop plants. Y. Dalpé reviews the classical concepts and explores new approaches to the systematics to gain a better understanding of the relationship of VAM fungi as a basis for their more effective exploitation. The influential results of molecular studies by L. Simon promise to fulfil those expectations. M. St-Arnaud et al., and N. Benhamou review the effects of VAM on susceptibility of host plants to pathogens. H. Vierheilig and Y. Piché address the phenomenon of non-host plants, and mechanisms that regulate their resistance to VAM infection. The status of indigenous VAM fungi under present-day agriculture, and what it should be if agriculture were to attain sustainability, are reviewed by C. Hamel, and by C. Plenchette and D. Strullu.

While ancestors and wild relatives of most agricultural crop plants need VAM to prosper, many of the north-temperate forest trees need ectomycorrhizal fungi to survive. J. Gagnon and C. Langlois report on the progress achieved in large-scale commercial "mycorrhization" of nursery seedlings under the auspices of the Québec Ministry of Natural Resources. The lesson here is that heady results obtained in a laboratory are seldom duplicated in the real world outside. We still know very little about forest microbiota. This ignorance is laid bare in L. Duchesne and K. Rigal's discussion of the impact of forest fires on soil microorganisms. Finally, D. Tagu and F. Martin depart into the exotic realm of eucalyptus, in pursuit of questions that only molecular biology can attempt to answer: what genetic interplay between a plant and the fungi underlies the formation of a novel organ that is ectomycorrhiza?

This book well represents Québec "mycorrhizology": the approach is unabashedly pragmatic. It is not that the authors are unaware of, or downplay, the contribution of basic research. On the contrary, it is the appreciation of the fundamental role of mycorrhizal symbiosis throughout the 400 million-year history of terrestrial flora, that has sustained these researchers' enthusiasm and faith in the vast potential of manipulating mycorrhizal associations for human benefit.

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## Poisonous Plants of Canada

By G. A. Mulligan and D. B. Munro. 1990. Publication 1842/E, Agriculture Canada, Ottawa. 96 pp.

## Plant Alert

By D. A. Metzger. 1990. Royal Ontario Museum, Toronto. 26 pp., illus. (English); 29 pp., illus. (French).

There is a wealth of literature on so-called "harmful" plants but most of this is pseudo-medical regurgitation of old, anecdotal, and often questionable information. These two publications, though very different in their objectives, share a delightfully different starting point. Both are compilations of the experiences and knowledge of active investigators and/or documented cases and strive to offer authoritative reviews of the toxicity of particular taxa in Canada.

*Poisonous Plants of Canada* is the most ambitious of the two, addressing plants known to have poisoned humans *or* domestic animals in Canada as determined from a careful review of the authoritative literature and from the experience of Agriculture Canada personnel. It is a scholarly effort, clearly intended to be more of a reference work for specialists than a general public "how-to" guide. A brief nomenclatural note commences each of over 200 entries, followed by a Canadian range description. This is followed by a description of the known toxicity of that species to human and/or domestic animals. Importantly, detailed reference to documentation supporting these observations is given with each treatment. Separate appendices of those plants found to be toxic for humans and domestic animals are included as summary lists. Unfortunately, no help is offered in the identification of any of these plants, nor is the reader provided with any direction in obtaining such assistance beyond a few lines on making dried samples. While authoritative and informative, *Poisonous Plants of Canada* could not be considered to be particularly "user friendly" for any but botanically well-informed readers.

*Plant Alert,* on the other hand, is extremely user friendly. This small bilingual booklet has a much less ambitious botanical scope than *Poisonous Plants of Canada,* restricting itself only to the most frequently encountered "problem" species reported to Toronto, Ontario, poison control centers. *Plant Alert* is also clearly aimed at the general public, with clear, excellent quality photographs of almost all of the two dozen or so plant species treated. Each treatment includes a plain language description of the appearance and habitat of the plant in question as well as a discussion of its toxicity. No references are provided so the reader is obliged to go on faith here, although an annotated listing of general literature is included at the end. A brief section on "Plants in Other Guises" — jewelry, ornaments, etc. — is a thoughtful and useful addition. Another very helpful feature is the inclusion of treatments of commonly reported non-toxic plants. What a great idea; many a rushed trip to the childrens' hospital or poison centre may be avoided by this reassuring section. Had the author expanded her selection to include the major species reported by poison centres in other Ontario communities, however, this helpful booklet could have embraced a province-wide scope and enjoyed a wider provincial audience.

Both publications successfully address their stated target audience and provide useful, well-produced information. One can easily imagine, however, that a hybrid publication combining the user friendly aspects of the one and the comprehensive, authoritative nature of the other would be a tremendous reference work indeed. The basis for a very useful and commercially successful publication is clearly indicated.

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## Haliburton Flora: An Annotated List of the Vascular Plants of the County of Haliburton, Ontario

By E. G. Skelton and E. W. Skelton. 1991. Life Sciences Miscellaneous Publications, Royal Ontario Museum, Toronto. 142 pp., illus.

In late 1983 Steve Varga published an article in the now-defunct *Plant Press* describing almost 30 regions of the province with on-going floristic compilation projects. The publication of such regional studies is widely recognized as important in developing a comprehensive understanding of floristics at a provincial, national and even international scale. Almost 15 years later, however, only a handful of these regional studies have seen the light of day. That may say more for the sorry state of basic field knowledge in Ontario than any bureaucratic and academic wailing. The Skeltons' *Haliburton Flora,* however, is a fine addition to that all-too-short list of recently published floras.

Eleanor and "Em" Skelton, both deceased shortly after the publication of this list, were amateurs in the most positive sense of that word. They studied botany for the love of it but they undertook their studies seriously and with care. For almost 20 years they scoured the rugged, beautiful Canadian Shield country of Haliburton County just south of Algonquin Park, col-

lecting over 2000 vouchers to support their observations. Each of their carefully prepared and labelled specimens is deposited in the Royal Ontario Museum herbarium (TRT). The Skeltons took great care to review Haliburton specimens in other collections, including private sources, and sought expert taxonomic opinion whenever possible.

The result is a fine record of Haliburton's flora, neatly presented in a well-produced, paper-bound volume with clear, readable type and an attractive colour cover. The species treatments are sparse - one to two lines - but manage to concisely describe the status, habitat, and distribution (the latter represented by a list of codes for the County's 23 townships) for each of 922 taxa (899 species) then known to occur in the County. The book is also significantly enhanced by an excellent introductory section describing the appropriate background context of geology, soils, vegetation, etc.

The *Haliburton Flora* suffers a bit from a lengthy publication process that did not allow for the inclusion of a relatively large number of additions made by others in the late 1980s. The declining health of the authors contributed to this, no doubt, but it did not prevent them from producing a competent, comprehensive list. The *Haliburton Flora* provides and excellent working list and will be a useful reference for any botanist working in the Canadian Shield country of southern and southcentral Ontario. It also constitutes a fine botanical legacy for a delightful and productive couple.

The Royal Ontario Museum is also to be congratuated for their encouragement and support of the Skelton's efforts and the publication of such a high quality, reasonably-priced product. The support of the lead provincial institution in the production of such valuable regional work is appropriate, important,... and shamefully rare, in Canada.

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## Trees in Canada

By John Laird Farrar. 1995. Fitzhenry & Whiteside Limited, Markham, Ontario and the Canadian Forest Service, Natural Resources Canada, Ottawa. x + 502 pp., illus. $40.00.

*Trees in Canada* is a wonderful reference and a steal at $40.00 (Canadian). The layout, type setting, color photographs, and black line drawings make it particularly easy to use. For those of us who relied on its predecessor *Native Trees of Canada*, the improvements are welcomed and readily apparent.

Specifically, Trees in Canada now contains over 300 species and includes for the first time commonly planted or naturalized trees (i.e., Nordmann fir, Siberian larch, Scots Pine, and, to my surprise, Baldcypress). For added convenience, all trees are stratefied into 12 Groups, and these groups are identified on the endleaves inside the front and back covers of the book. Red colored tabs are used to show where these Groups appear in the book. The system is efficient and helpful. However, as in previous versions, the trees are also stratified by "The Conifers" and "The Broadleaf Trees" in the table of contents, for those who may have found that helpful. The two page per species format has been maintained, at least for all of the native Canadian tree species, and Rowe's map of the *Forest Regions of Canada* has been retained. New additions are: maps of the Eastern and Western Plant Hardiness Zones in Canada, "Keys to Groups and Selected Genera", "Winter Keys to the Genera", a listing of "Botanical Authors", and a section titled "Meanings of Tree Names". Also for the first time, there are "Quick Recognition" tips for all the native tree species. I found these last three additions particularly "neat", informative and helpful.

What I did not like about the book was the fact that species maps do not accurately show the true range of the species. For example, from what is presented in this book one might conclude the range of *Pinus contorta* Dougl. ex Loud. var *latifolia* Englem. only extends as far south as Wyoming, which is wrong. However, to the credit of the new version, one should note that the tree distributions in the previous versions of this book used to stop at the borders between the United States and Canada. So the author is trying to be more inclusive. However, I suspect from his perspective one has to decide where to cut these distributions off. Some of the species in this book are also found in Mexico and elsewhere.

I am the kind of guy who loves to find and, when possible, identify trees. When visiting a new area of the continent I take time to view the trees. I find "tree viewing" to be more fun than "bird watching", because trees tend to remain in place long enough for me to get the job done. However, because of this interest, I have bought more than a few tree identification books. In my opinion, *Trees in Canada* is now one of the better books in my collection, so I recommend it without reservation to all botanists, greenhouse operators, landscape architects and nature enthusiasts. And I believe it will make an excellent Christmas gift.

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## The Sunflower Family (Asteraceae) of British Columbia Volume 2, Astereae, Anthemideae, Eupatorieae and Inuleae

By George W. Douglas. 1995. Royal British Columbia Museum, Victoria, British Columbia. vi + 393 pp., illus. $29.95

In 1982 the British Columbia Provincial Museum published *The Sunflower Family (Asteraceae) of British Columbia Volume 1 -Senecioneae* by George W. Douglas and illustrated by Elizabeth J. Stephen as Number 23 of the Occasional Papers Series. In the introduction of this volume the author anticipated publishing the eight tribes set up by Bentham in five volumes. Volume two was to include the Astereae, volume three the Anthemideae, Eupatoreae and Inuleae, Volume four the Cichoreae, and volume five the Cynareae and Heliantheae. The volume just published, however, includes the four tribes indicated in the title and the projected volume three will include the Lactuceae (Cichorieae), Cardueae (Cynareae) and Heliantheae. Hopefully, we will not have to wait so long for this last volume.

In the introduction Douglas describes the world-wide distribution of the Asteraceae (Compositae), one of the largest plant families of which at least some species are known to almost everyone. He then discusses the historic and economic uses, floral form and structure, floral biology and pollination, seed dispersal, the arrangement of the tribes and genera in his volumes on British Columbia's Sunflower family together with information on the location of the over 50 000 specimens he has examined during the writing. He describes his treatment as conservative like those of Cronquist and Welsh, but unlike Cronquist he has treated geographically separate, or mainly separate, taxa of a species at the subspecies level and those with geographically sympatric ranges at the varietal level. In addition, he has not recognized any taxa at the forma level. Here also is a key to the Asteraceae tribes together with a series of excellent line drawings to help the user in working through this key.

In the four tribes a total of 27 genera and 132 species are recognized: *Achillea* (2), *Anaphalis* (1), *Antennaria* (11), *Anthemis* (3), *Artemisia* (18), *Aster* (23), *Bellis* (1), *Brickellia* (1), *Chamomilla* (3), *Chrysanthemum* (3), *Chrysothamnus* (2), *Conyza* (1), *Cotula* (1), *Erigeron* (28), *Eupatorium* (1), *Euthamia* (2), *Filago* (2), *Gnaphalium* (7), *Grindelia* (2), *Haplapappus* (3), *Heterotheca* (1), *Inula* (1), *Leucanthemum* (3), *Machaeranthera* (1), *Matricaria* (3), *Psilocarphus* (2), *Solidago* (6), *Tanacetum* (3), and *Townsendia* (3).

In the main text, like the key to the Asteraceae tribes, the keys to genera within the tribes are provided with drawings to aid progress through the keys. The genera and species in each of the tribes are in alphabetical sequence. Each genus and species has an interesting introductory paragraph which includes numbers, habitats, characteristics, range, and uses, if any. This is followed by a detailed description references, comments if required, and chromosome numbers, if known. Each species is accompanied by a full page of drawings depicting habit, heads, florets and other characters as required. These, like the ones in the keys were produced by the careful touch of Elizabeth J. Stephen. Distribution maps are also provided for all species.

The work is concluded with a glossary; Appendix 1: British Columbia Astereae, Anthmideae, Eupatoreae, and Inuleae species and their synonyms; Appendix 2: Synonyms of British Columbia Astereae, Anthemideae, Eupatoreae, and Inuleae; Appendix 3: Excluded taxa; Literature cited; and an index.

Like the previous volume, this is an excellent treatment which will be welcomed by botanists, students, and naturalists both in and adjacent to British Columbia.

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ENVIRONMENT

## Saving Nature's Legacy: Protecting and Restoring

By Reed F. Noss and Allen Y. Cooperrider. 1994. Island Press, Washington, D.C. 416 pp., Cloth U.S. $48.00; Paper U.S. $24.50.

Biodiversity, in recent years, has become a topic of concern within the global community. A Convention on Biological Diversity has been created, resulting in Canada developing a strategy in response to the convention. *Saving nature's legacy* is written to provide the land managers, who will be responsible for developing and implementing policy to conserve biodiversity, a guide. The authors "put forth a bold vision of what it might take to maintain all of biodiversity…".

Noss and Cooperrider provide a book complete with a detailed table of contents, a glossary, index, literature cited list, species list, and several tables for comparison of methodologies. *Saving nature's legacy* also provides (1) historical background to the sub-

ject matter, (2) methodology, (3) a close look at management of forests, rangelands, and aquatic ecosystems, and (4) future needs. The book is not meant to be a complete literature review of the topic but provides some key references for further reading. These all complement the thorough and very readable text, assuring the reader easy access to the information withing its pages for later referral.

The book is one which should be recommended to any one interested in biodiversity issues. Even though the book is mainly American in content it should be useful in the Canadian situation. One word of warning, the book challenges and critiques present-day management of natural resources. For those attempting to implement conservation of biodiversity, Noss and Cooperrider outline a conservation plan which will be challenging, at the very least, to implement.

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## Where the Sky Began: Land of the Tallgrass Prairie

By John Madson. 1995. Iowa State University Press, Ames. xiv + 326 pp. Cloth U.S. $24.95

In this revised edition Madson presents a magnificent overview of the tallgrass prairies, in which two basic themes are addressed. The book begins with a review of some of the basic biological features of tallgrass prairies, including soil type, moisture regime, fire history, climatic conditions, productivity, flora, and fauna. Unfortunately, there is an inherent and unavoidable danger with using this approach – oversimplification. While there is little doubt that climate and fire history play a significant role in the establishment and maintenance of these grasslands, these notably complex ecosystems are still poorly understood. Recent discoveries such as plant-fungal co-evolutionary relationships (Clay 1988, 1991) indicate that we have much to learn. Nevertheless, as presented and intended, the author has successfully woven science into a series of anecdotes which I found pleasantly informative and enjoyable to read. More importantly however, readers not familiar with tallgrass prairie leave with a basic understanding of the unique biology and ecology of this rare type of grassland.

In the second part of the volume, anthropogenic effects are considered. Madson makes an excellent point concerning human nature and the economic value of these once vast and untouched prairies over the last century. That is, the prairies were considered to be a resource that could be exploited at will. In our tenacity to tame the prairies and put the land to good use we have almost successfully eradicated the tallgrass prairie. Today it is estimated that less than 1% of the original tall grass prairie exists in small disjunct patches (a number of these patches are listed in the Appendix). Unfortunately, in our haste to clear the land, the number of reliable studies describing the ecology and inventories of the original flora and fauna are few, and provide us with only a partial picture of what the structure and composition of natural tallgrass prairie was like. However, over the last two decades we have made significant advances in restoring prairies to their natural state and it is these prairies that are now allowing us to better understand these complex prairie ecosystems.

I found the overall quality of the book to be good. However, I was disappointed with the poor quality of the line drawings. The publishers should have considered colored photographs, such as the one used for the jacket cover or at least watercolors for the illustrations. In addition, I found the consistent use of colloquial names for the flora and fauna, without reference to their scientific names frustrating. This problem could have been eliminated by adding the scientific name in brackets the first time the common name was used.

After reading this book I felt that the role the prairies have had on our way of life is beginning to come full circle. The native people viewed themselves as part of the prairie ecosystems, living on what the land naturally provided to them. Over the last 100 years the prairies have been exploited and nearly completely decimated. Floral and faunal species, many of which we will only know through paleoecological studies, are extinct. However, the number of tallgrass prairie restoration projects is growing every year, and with time we may have something more than disjunct patches of the tallgrass prairie that we can pass on as part of our heritage to future generations.

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## Masterworks of Man and Nature

Edited by Robert Osborne. 1994. Facts on File. 2nd edition. Harper-MacRae, Patonga, Australia 402 pp. $43.95

Robert Osborne and Mark Swadling with a host of writers, photographers and production people have assembled this book which documents the World Heritage Convention's list of natural and cultural sites. Endorsed by UNESCO and IUCN (The World Conservation Union) the book is both a list of sites and an awareness campaign for the World Heritage Convention. As royalties from the sale of these books go to the World Heritage Fund, the publication is a fund-raising scheme for the World Heritage Fund. It is an attractive, large coffee-table picture book which is easy to handle and invites one to look at it immediately. I had an hour of fun with it initially just locating the places which I have visited and reading the pages around them.

On closer inspection, I was impressed with many of the sites and the composition of the text. Far from being the ordinary travelogue, the book identifies sites of interest for their cultural or natural heritage. Certainly there is a come-and-see aspect to much of the book, but there is also a come-and-see but don't touch aspect which is refreshing. Also refreshing are the number of sites which are identified as being wildlife refuges, in particular wildlife refuges for mammals and reptiles. There are a few sites which identify birds as the principle attraction, but of the wildlife sites they are the minority. Rare African primates, elephants and deer are more often identified in the sites than are birds. Some of the sites are identified as important resting places in migration as well as the homes of rare bird species.

This is not another pretty bird book. The whole tone of the book is conservation, history, events, and policies which influence our modern world and how each of these areas are entwined. I kept wondering why other sites were not included and how they could have been missed. For instance of the wonders of the world included, Niagara Falls did not make the list! Have we written off this landform or is there nothing in particular to save there? I have to disagree somehow. Canada did manage to include nine different sites and an essay by Harold Eidsvik, the Director of the Canadian Parks Services, on old growth forests. It is a measure of our conflicts though that none of the Canadian old growth forests have made the list to date.

I find the fact that I am bothered somewhat by the contents of the book to be a good thing. A prophetic stance should bother us and, even better, move us to action. The book has a mildly prophetic character just by telling us that there are valuable natural and historical things slipping through our fingers and we can appreciate the value of holding onto them. On the other hand one can appreciate the book as a beautiful thing in itself, and I would not have any trouble tellng a school to buy it as a picture book or giving it as a gift to someone is who is going traveling and looking for exciting places to visit. I can also recommend it to a high school student interested in conservation, knowing that it will be easy reading with a solid message.

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## The Everglades Handbook: Understanding the Ecosystem

By Thomas E. Lodge. 1994. St. Lucie Press, Delray Beach, Florida. xix + 228 pp., illus. paper U.S. $32.50.

Because I spent two winters in the wildlands of southern Florida in the early 1970s, I looked forward to a book that promised a comprehensive overview of the biology and ecology of that marvelous region. I was not disappointed; Lodge has compiled a readable, useful, and enjoyable volume.

The book begins with a brief overview of geology, history, and landscape development. Lively descriptions of "Environments" (freshwater marshes, hardwood hammocks and other tree islands, pinelands, mangroves, coastal levees and saltmarshes, estuarine and marine waters) occupy 70 pages. A slightly longer section covers biogeography and the major groups of organisms.

The author's interests in fish biology and zoogeography are evident. I appreciated the discussion of the role of the alligator in shaping microrelief and vegetation. Coverage of some topics, however, including soils, sawgrass autecology, amphibians, and "coastal lowland" vegetation is curiously brief. The exclusion of the Big Cypress Swamp seems arbitrary. Native American use of southern Florida is scarcely mentioned, although 20th century human impacts and restoration issues are discussed in the final 25 page chapter. There is a 263 item bibliography and many text citations. A 27-page index enhances the value of the book for reference. Numerous black-and-white photographs are mostly clear and complement the text, especially for non-biologist readers. The author's charming preface recounts reading the entire manuscript aloud to Everglades conservationist and author Marjory Stoneman Douglas, who (at the age of 99) commented on the text and wrote an introduction.

On the whole, *The Everglades Handbook* is well written and well edited. I found a few statements confusing (e.g., "[The snowy egret] may even feed on the wing, *similar to a sea gull*"). There are too many instances of subject-verb disagreement. Some readers may find use of the gender-biased "man" uncomfortable (e.g., "accustomed to the presence of man," page 138). There are few typographic errors (all wetland ecologists should write the words "repellent," "mosquitoes", and "gases" on the backs of their hands). In five years a revised edition could fill some of the gaps in coverage, and report on pollution control and hydrological restoration.

*The Everglades Handbook* will inform efforts to restore and protect one of the continent's great wetlands. I hope regulators, managers, politicians, business people, scientists, ecotourists, and conservationists who work in or visit Florida will study this book. I hope it will also serve as a model for comparable volumes on other wetland regions.

ERIK KIVIAT

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MISCELLANEOUS

## Evolutionary Naturalism

By Michael Ruse. 1995. Routledge, London. 316 + x pp. U.S. $49.95

Naturalism is more than the field biology dominating this journal: more broadly it refers, in all of science, the arts, and ethics, to approaches rooted in experience of the natural world. Evolutionary naturalism, referring to the approach based on an evolutionary perspective, receives a fine treatment in ths book from Michael Ruse, well known, and appropriately so, as a philosopher of biology who makes his subject matter understandable and appealing. Nine essays are grouped into three sections, with useful introductions. Under Case Studies, Ruse considers the concept of natural selection as developed by Darwin and Wallace for evidence of the importance of the route in the discovery of the features of a theory, and the diagrams of adaptive landscapes by Sewall Wright for the frequently key role of pictures in communicating concepts, resulting in two stimulating essays. There is also a third, and almost gossipy, essay on the participants, and their impacts, in the paleontological controversy of punctuated equilibria.

Under Evolutionary Epistemology, Ruse examines possible parallelisms in the developments of societies, sciences, and the organic world, including pairwise comparisons, but more rigorous treatment is needed to achieve definite conclusions. The familiar issue of the historically close linkage of the theory of evolution with the concept of progress is nicely presented, followed by an excellent exposition of evolutionary epistemology that Ruse correctly regards as the lynchpin of the book. The adaptive basis of our cognitive abilities, their social and scientific consequences, and responses to criticisms are all beautifully narrated. Under Evolutionary Ethics there are equally excellent essays on the role of cultural values in evolutionary biology and on a sociobiological approach to ethics. Responding to critics always carries the threat of becoming dull, and such is the case here, but particularly valuable attention is paid to the refinement of epistemic values in science, to questioning the cogency of the naturalistic fallacy, and to a view of morality as an adaptive product of altruism.

The arguments are made with Ruse's customary balance and zest, and broad historical and philosphical sources are usefully invoked in a manner highly agreeable to practicing biologists, as might be expected from one who regards evolutionary thought as "one of the greatest testaments to human intellectual achievement". Not that the treatment is free of all redundancies, such as the issue of progress, or of philosophical surprises, such as the rejection of "the notion of a reality beyond our experience". There is a good bibliography and insufficient index (especially regrettable in such an important book). In conclusion, Ruse does an excellent job in promoting the central importance of naturalism as THE approach providing genuine understanding of our world at large. His contribution is especially important in the face of non-natural challenges such as fundamentalism, occultism, and intellectual sophistry.

PATRICK W. COLGAN

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## NEW TITLES

### Zoology

**Biogeography of the reptiles of south Asia.** 1996. By I. Das. Kreiger, Melbourne, Florida. U.S. $27.50.

†**A birder's guide to Florida.** 1996. By B. Pranty. 4th edition. American Birding Association, Colorado Springs, Colorado. 388 pp., illus. U.S. $18.95.

†**Birding in metro Halifax: a month-by-month adventure guide.** 1996. By C. Stevens. Nimbus, Halifax. x + 310 pp.

†**Bird song: identificaiton made easy.** 1996. By E. Jardine. Natural Heritage/Natural History, Toronto. 207 pp., illus. $14.95.

†**Coloniality in the cliff swallow: the effect of group size on social behavior.** 1996. By C. R. Brown and M. B. Brown. University of Chicago Press., Chicago. xiii + 566 pp., illus. Cloth U.S. $95; paper U.S. $95.

†**The colonial waterbirds of Great Slave Lake, Northwest Territories: an annotated atlas.** 1995. By J. Sirois, M. A. Fournier, and M. F. Kay. Occasional Paper No. 89. Canadian Wildlife Service, Yellowknife. 59 pp., illus. Free.

**Coral snakes of the Americas: biology, identification, and venoms.** 1996. By J. A. Roze. Kreiger, Melbourne, Florida.

†**Duck use of the costal habitats of James Bay.** 1996. By A. Reed, R. Benoit, R. Lalumiere, and M. Julien. Canadian Wildlife Service, Saint-Foy, Québec. 47 pp., illus. Free. Available in French.

**The ecology of a symbiotic community: volume 1: population biology of the Japanese lizard *Takydromus tachydromoides* (Schlegel) (Lacertidae) and volume 2: the component symbiote community of the Japanese lizard *Takydromus tachydromoides* (Schlegel) (Lacertidae).** 1996. By S. R. Telford, Jr. Kreiger, Melourne, Florida.

†**Female control: sexual selection by cryptic female choice.** 1996. By W. G. Eberhard. Princeton University Pess, Princeton. xiv + 501 pp., illus. Cloth U.S. $85; paper U.S. $29.95.

**A guide to the frogs and toads of Belize.** 1996. By J. R. Meyer and C. F. Foster. Kreiger, Melbourne, Florida. U.S. $24.50.

†**Javelinas and other peccaries: their biology, management, and use.** 1996. By L. K. Sowls 2nd edition. Texas A&M University Press, College Station. 352 pp., illus. U.S. $49.95.

**Kaleidoscope tree boas: the genus *Corralus* of tropical America.** 1996. By P. J. Stafford and R. W. Henderson. Kreiger, Melbourne, Florida.

***Landscape approaches in mammalian ecology and conservation.** 1995. Edited by W. Z. Lidicker, Jr. University Minnesota Press, Minneapolis. ix + 215 pp., illus. U.S. $35.95.

***Larvae of the North American caddisfly genera (Trichoptera).** 1996. By G. B. Wiggins. 2nd edition. University of Toronto Press, Toronto. 457 pp., illus. $110.

**Lizards.** 1996. By M. Rogner. Translated by J. Hackworth (1992, 1994 German edition) 2 volume set. Kreiger, Melbourne, Florida.

†**Lone star dinosaurs.** 1995. By L. Jacobs. Texas A&M University Press, College Station. xiv + 150 pp., illus. U.S. $27.95. (Canadian distributor: University British Columbia Press, Vancouver $39.95)

†**Messages from an owl.** 1996. By M. R. Terman. Princeton U. P., Princton. xi + 217 pp., illus. U.S. $24.95.

**Natural history of monitor lizards.** 1996. By H. F. Delisle. Kreiger, Melbourne, Florida. U.S. $24.50.

†**Neotropical birds: ecology and conservation.** 1996. By D. F. Stotz, J. W. Fitzpatrick, T. A. Parker III, and D. K. Moskovits. University Chicago Press, Chicago. xx + 478 pp., illus. + plates. Cloth U.S. $100, paper U.S. $37.50.

†**Ontario birds: a field guide to 125 common birds of Ontairo.** 1996. By C. Fisher. Lone Pine, Edmonton. 159 pp., illus. $17.95.

†**Oppossums, shrews, and moles of British Columbia.** 1996. By D. W. Nagorsen. Royal B.C. Museum Handbook. University British Columbia Press, Vancouver. 160 pp., illus. $24.95.

†**The Princeton field guide to the birds of Australia.** 1996. Edited by K. Simpson. 5th edition. Princeton University Press, Princeton. viii + 400 pp., illus. U.S. $39.50.

†**Ruddy ducks and other stifftails: their behavior and biology.** 1996. By P. A. Johnsgard and M. Carbonell. University of Oklahoma Press, Norman. xiv + 291 pp., illus. U.S. $49.95.

†**Shrikes (Laniidae) of the world: biology and conservation.** 1995. Edited by R. Yosef and F. E. Lohrer. Volume 6, No. 1. Proceedings of the Western Foundation of Vertebrate Zoology, Camarillo, California.

†**Spell of the tiger: the man-eaters of Sundarbans.** 1995. By S. Montgomery. Houghton Mifflin, Boston. xvii + 232 pp., illus. U.S. $12.95.

**The thermal warriors: Strategies of insect survival.** 1996. By B. Heinrich. Harvard University Press, Cambridge. 332 pp., illus. U.S. $27.

### Botany

†**The book of swamp and bog: trees, shrubs, and wildflowers of eastern freshwater wetlands.** 1995. By J. Eastman. Stackpole Books, Mechanicsburg, Pennsylvania. xv + 237 pp., illus. U.S. $16.95.

†**Catkin-bearing plants of British Columbia.** 1996. By T. C. Brayshaw. Revised edition. Royal British Columbia Museum, Victoria. 192 pp., illus. $24.95.

†**A descriptive forest inventory of Canada's forest regions.** 1996. By S. L. Gray. Information Report PI-X-122. Canadian Forestry Service, Petawawa. 192 pp., illus.

**A field guide to the families and genera of woody plants of northwest South America (Columbia, Ecuador, Peru).** 1993. By A. W. Gentry. University Chicago Press. Chicago. 918 pp., illus. Cloth U.S. $75; paper U.S. $45.

*__Field guide to the palms of the Americas.__ 1995. By A. Henderson. G. Galeano, and R. Bernal. Princeton University Press, Princeton. ix + 352 pp., illus + 64 plates. U.S. $75.

**Forest ecosystem classification for Manitoba: field guide.** 1995. By C. Zoladeski. University British Columbia Press, Vancouver. 205 pp., illus. $24.95.

†**Forest plants of central Ontario.** 1996. By B. Chambers, K. Legasy, and C. V. Bentley. Lone Pine, Edmonton. 448 pp., illus. $24.95; U.S. $19.95.

**Plant collecting for the amateur.** 1996. By T. C. Brayshaw. Revised edition. Royal British Columbia Museum, Victoria. 48 pp., illus. $8.95.

†**Plants of southern interior British Columbia.** 1996. Edited by R. Parish, R. Coupe, and D. Lloyd. Lone Pine, Vancouver. 463 pp., illus. $24.95; U.S. $19.95.

†**Trees and shrubs of British Columbia.** 1996. By T. C. Brayshaw. Royal British Columbia Museum Handbook. University British Columbia Press, Vancouver. 320 pp., illus. $24.95.

*__Trees in Canada.__ 1995. By J. L. Farrar. Fitzhenry & Whiteside, Markham, Ont. x + 502 pp., illus. $40.

†**Wetland plants of Oregon and Washington.** 1995. By B. J. Guard. Lone Pine, Redmond, Washington. 239 pp., illus. U.S. $19.95.

†**Wild flowers: legends, poems, and paintings.** 1996. By N. R. Ranson and M. J. Laughlin. Edited by H. E. Laughlin. Texas A&M University Press, College Station. 102 pp., illus. U.S. $16.95.

### Environment

†**Achieving sustainability in Canada.** 1996. Edited by A. Dale and J. B. Robinson. University British Columbia Press, Vancouver. c256 pp., $75.

†**Dealing with risk: why the public and the experts disagree on environmental issues.** 1996. By H. Margolis. University Chicago Press, Chicago. c200 pp., illus. U.S. $24.95.

†**Dictionary of natural resource management.** 1996. By J. and K. Dunster. University British Columbia Press, Vancouver. c360 pp., illus. $90; U.S. $74.95.

†**Ecology of the Bering Sea: a review of Russian literature.** 1996. Edited by O. A. Mathiesen and K. O. Coyle. Report 96-01. University of Alaska Sea Grant College, Fairbanks. 306 pp., illus. U.S. $25.

**Global diversity assessment.** 1995. Edited by V. H. Heywood. Cambridge University Press, Cambridge. 1140 pp.

†**Hiking the ancient forests of British Columbia and Washington.** 1996. By R. Stoltmann. Lone Pine, Edmonton. 191 pp., illus. $19.95; U.S. $15.95.

†**The ice-age history of national parks in the Rocky Mountains.** 1996. By S. A. Elias. Smithsonian Institute Press, Washington. xii + 170 pp., illus. U.S. $16.95.

†**Life in 2030: exploring a sustainable future in Canada.** 1996. By J. B. Robinson. University British Columbia Press, Vancouver. c224 pp., $25.95.

†**Mountain bike Nova Scotia: a guide to off-road cycling in Nova Scotia.** 1996. By G. Brown and K. Degooger. Nimbus, Halifax. 181 pp., illus. $12.95.

**Passing the buck: federalism and Canadian environmental policy.** 1996. By K. Harrison. University British Columbia Press, Vancouver. c244 pp. $70.

†**People and environment: development for the future.** 1996. Edited by S. Morse and M. Stocking. University British Columbia Press, Vancouver. c224 pp. $24.95.

†**Population dynamics in ecological space and time.** 1996. Edited by O. E. Rhodes Jr., R. K. Chesser, and M. H. Smith. University Chicago Press, Chicago. c336 pp., illus. Cloth U.S. $50; paper U.S. $17.95.

**Science and ecosystem management in the National Parks.** 1996. Edited by W. L. Halverson and G. E. Davis. University Arizona Press, Tuson. 224 pp., illus. Cloth U.S. $45; paper U.S. $15.95.

†**Sea Kayaking in Nova Scotia: a guide to paddling routes along the coast of Nova Scotia.** 1996. By S. Cunningham. Nimbus, Halifax. ix + 244 pp., illus. $16.95.

†**Species diversity in ecological communities: historical and geographical perspectives.** 1994. Edited by R. E. Ricklefs and D. Schlater. Chicago University Press, Chicago. 416 pp., illus. Cloth U.S. $98; paper U.S. $32.50.

†**Status of the World ocean and its biodiversity.** 1995. By D. E. McAllister. Ocean Voice International, Box 37026, Ottawa, K1V 0W0. Sea Wind 9(4). 72 pp. $7.50 + $2.50 postage.

### Miscellaneous

†**Charles Darwin voyaging.** 1996. By J. Browne. Princeton University Press, Princeton. xv + 605 pp., illus. U.S. $18.95.

*__The fossils of the Burgess shale.__ 1994. By D. E. G. Briggs, D. H. Erwin, and F. J. Collier. Smithsonian Institute Press, Washington. xvii + 238 pp., illus.

†**Hiking Nova Scotia: thirty of Nova Scotia's best hiking trails.** 1995. By J. Light. Nimbus, Halifax. vi + 106 pp., illus.

**Monad to man: the concept of progress in evolutionary biology.** 1996. By M. Ruse. Harvard University Press, Cambridge. 640 pp., illus. U.S. $49.95.

*__River out of Eden: a Darwinian view of life.__ 1995. By R. Dawkins. Basic Books, Harper Collins, New York. 172 pp., illus. U.S. $20; Cdn. $28.

†**The shape of life: genes, development, and the evolution of animal form.** 1996. By R. A. Raff. University Chicago Press, Chicago. c520 pp., illus. cloth U.S. $55; paper U.S. $29.95.

*assigned for review
†available for review

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# The CANADIAN FIELD-NATURALIST

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# The Ottawa Field-Naturalists' Club

FOUNDED IN 1879

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His Excellency The Right Honourable Roméo LeBlanc, P.C., C.C., C.M.M., C.D.,
Governor General of Canada

The objectives of this Club shall be to promote the appreciation, preservation and conservation of Canada's natural heritage; to encourage investigation and publish the results of research in all fields of natural history and to diffuse information on these fields as widely as possible; to support and cooperate with organizations engaged in preserving, maintaining or restoring environments of high quality for living things.





Those wishing to communicate with the Club should address correspondence to: The Ottawa Field-Naturalists' Club, Box P.O. Box 35069, Westgate P.O. Ottawa, Canada K1Z 1A2. For information on Club activities telephone (613) 722-3050.

# The Canadian Field-Naturalist

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Second Class Mail Registration No. 0527 – Return Postage Guaranteed. Date of this issue: October-December 1996 (March 1997).

**Back Numbers and Index**
Most back numbers of this journal and its predecessors, *Transactions of The Ottawa Field-Naturalists' Club,* 1879-1886, and *The Ottawa Naturalist*, 1887-1919, and *Transactions of The Ottawa Field-Naturalists' Club and The Ottawa Naturalist – Index* compiled by John M. Gillett, may be purchased from the Business Manager.


**Cover**: Dorsal (left) and lateral (right) view of the head of a Night Snake found 5 September 1992 between Oliver and Osoyoos, British Columbia, and photographed 15 January 1993 by Tom Gore, University of Victoria, British Columbia (The same snake is also depicted in Figure 1, page 623). Note the characteristic vertical eye pupils (in bright light) visible in both views. The only other snakes in Canada to have vertical pupils are the rattlesnakes (genera *Crotalus* and *Sistrurus*). Photograph courtesy of Patrick T. Gregory, Department of Biology, University of Victoria, Victoria, British Columbia V8W 3N5. See paper on new records and diet of the Night Snake in British Columbia by Howard Lacey, Christopher H. Shewchuk, Patrick T. Gregory, Michael J. Sarell, and Linda A. Gregory, pages 620-625.

# The Canadian Field-Naturalist

Volume 110, Number 4 September–December 1996


# The Land Mammal Fauna of Southeast Alaska


STEPHEN O. MACDONALD[1,2] and JOSEPH A. COOK[2]

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MacDonald, Stephen O., and Joseph A. Cook. 1996. The land mammal fauna of southeast Alaska. Canadian Field-Naturalist 110(4): 571–598.



Poorly documented distributions for most mammal species in southeast Alaska have long hampered studies of this highly diverse and insular fauna. New information based on 4280 specimens in the University of Alaska Museum and a review of other large collections is reported for 54 species of land mammals that occur or have recently occurred in Southeast Alaska. Based on the presence of endemic taxa or unique combinations of taxa, five subregions can be identified. Patterns of species richness and endemism are similar to other archipelagos. The origin of this fauna has been complex and includes species with Beringian and/or southern refugia affinities. Fossil mammals recovered from Prince of Wales Island and the large number of endemics suggest a coastal corridor along the continental shelf that allowed the movement of a number of mammals into southeast Alaska prior to the Fraser glacial advance.



Key Words: mammal, endemic, conservation, island, temperate rainforest, Alexander Archipelago, Alaska.


For systematists and biogeographers, Alaska remains one of North America's last frontiers; nowhere is this sense of frontier more pronounced than amid the hundreds of islands, fiords, and mountains that constitute Southeast Alaska, the "panhandle" of the 49th state. Indeed, documentation of this complex region's biological diversity remains at the early stages of exploration and discovery. Even for such high-interest animals as mammals, basic information on distribution and taxonomic status has been limited, unfocused, or inaccessible, resulting in only broad (Hall 1981; Manville and Young 1965) or popular (Dufresne 1946; Rearden 1981) treatments. An unfortunate consequence is that the tremendous potential of this region for evolutionary, biogeographical, and ecological investigations has not been realized. Given the accelerating rate of human-induced stresses and changes on the region's terrestrial and marine ecological systems, it is even more disturbing that we lack detailed and accurate information for making sound conservation evaluations and wise management decisions.

Knowledge of the distribution and taxonomy of the region's mammals (and particularly its "nongame" mammals) has until recently been based on field collections made in the late 1800s and early 1900s, notably by the United States Biological Survey (U.S. National Museum, Washington, D.C.) and the Alexander Alaska Expeditions (Museum of Vertebrate Zoology, Berkeley, California). With few exceptions, these have been our primary sources of information despite their limitations in geographic scope, time spent at collecting localities, and number of specimens obtained.

In this paper, we provide new information (gathered primarily by UAM through the field season in 1995), corrections, and a current overview of the distribution and taxonomic status of the land mammals that occur or have recently occurred in Southeast Alaska. The marine mammals (24 species of pinnipeds, cetaceans, and the Sea Otter, *Enhydra lutris*) of Southeast Alaska are not considered here.

## Area of Study

Southeast Alaska (Figure 1) is defined as the region south of the Malaspina Glacier (59°45′N latitude) and north of Dixon Entrance (54°30′N latitude). With its approximately 16 000 km of shoreline, Southeast Alaska extends some 800 km north to south and 160 km east to west. This region is a naturally fragmented and complex mosaic of hundreds of small to large islands (the Alexander Archipelago), deep fiords, straits and inlets, and a mountainous mainland with numerous and extensive glaciers and ice fields. More than 1000 islands constitute the archipelago with Prince of Wales Island being the largest (> 5000 km$^2$; Orth 1967).

Nelson (1887) and Swarth (1911, 1936) recognized this region as zoogeographically distinct, and termed it the Sitkan district. Along the narrow strip of mainland, the Coastal and St. Elias mountain ranges delimit the eastern border of the region. They rise precipitously to over 5000 m in elevation to form a climatic barrier between the heavy rainfall and relatively mod-

erate temperatures of Southeast Alaska and the dry and more extreme temperatures of interior British Columbia. These ranges and their ice fields also act as effective physical barriers to plant and animal dispersal between the two distinct regions. Six major rivers, the Alsek, Chilkat, Taku, Whiting, Stikine, and Unuk drainages, transect these mountain ranges and may function as dispersal corridors.

General overviews and descriptions of the region can be found in Swarth (1936), Klein (1965), Harris et al. (1974), and Mann (1986). Southeast Alaska and coastal British Columbia embody the most extensive temperate rainforest in the world. Together they contain a large percentage of the remaining, uncut ancient forests (Alaback 1991). In recent decades this region has been experiencing significant impacts from large-scale logging, roadbuilding, and other human activities. Although much of the international conservation focus has been on fragmentation of tropical rainforests (Lovejoy et al. 1986; Saunders et al. 1991), it is quite clear that temperate coastal forests may be experiencing similar effects.

## Methods and Materials

The following accounts incorporate previously unpublished distribution records obtained from field work conducted through the University of Alaska Museum (UAM), University of Alaska, Fairbanks (UAF), over the past thirteen years. As a result of these efforts, UAM houses some 4280 mammal specimens (including study skins, skeletons, fluid preservations, frozen tissues, karyotypes, and ectoparasites) from across the region (through December 1995). We supplement these specimens with published accounts and verified records from other collections that have specimens and archival information on Southeast Alaska mammals, including those of the American Museum of Natural History (AMNH), Carnegie Museum of Natural History (CMNH), Glacier Bay National Park (GBNP), University of Kansas (KU), University of British Columbia (UBC), University of California Los Angeles (UCLA), University of California Berkeley (MVZ), University of Puget Sound (UPS), United States National Museum (USNM), and the Alaska Department of Fish and Game (ADF&G). Those institutions contain an additional 4600 specimens. Finally, we have relied on the personal observations of several knowledgeable residents of the region (details on file at UAM).

Of the 48 native species extant, 25 (52%) are known at the regional scale from fewer than 30 specimens. We now have varying levels of specimen representation from 87 islands (Table 1) of the > 1000 that constitute the Alexander Archipelago. The U.S. Biological Survey and the Alexander Alaska Expeditions sampled 22 islands early this century. Generally, coverage has focused on the larger islands. With few exceptions, however, most of our knowledge remains rudimentary and poorly represented with specimens. *Peromyscus keeni* with 2133 specimens, *Sorex monticolus* with 1119, *Microtus longicaudus* with 655, *Ursus arctos* with 636, *Sorex cinereus* with 633, and *Mustela vison* with 571 are the best documented species. Species that remain poorly represented include bats, many of the larger mammals, and most of the species with limited distributions.

Scientific nomenclature follows Wilson and Reeder (1993), with recent changes by Hogan et al. (1993). Vernacular names and the arrangement of the taxonomic accounts generally follow Jones et al. (1992). Subspecies (Hall 1981, unless otherwise noted) are reported for those taxa that are polytypic in Southeast Alaska. Information on specimens is available from JAC upon request.

## Annotated List of Species

### *Sorex cinereus* Kerr, 1792, Masked Shrew

*Sorex cinereus* occurs along the entire coastal mainland of Southeast Alaska, on islands of the Alexander Archipelago north of Sumner Strait (except Admiralty Island), and on islands in close proximity to the mainland south of Sumner Strait. Two subspecies, *S. c. streatori* Merriam (type locality = Yakutat) and *S. c. cinereus* Kerr, have been recognized in this region, the latter from White Pass only (Jackson 1925, 1928; Hall 1981; Antell 1987).

Mainland specimen records have been reported by several investigators (Merriam 1895; Osgood 1900; Swarth 1911; Jackson 1928; Baker 1951; Antell 1987), in addition to more recent unpublished UAM records. Island specimen records include Baranof, Bell, Black, Chichagof, Douglas, Etolin, Gedney, Grant, Gravina, Hassler, Inian, Kruzof, Kuiu, Kupreanof, Lemesurier, Mitkof, Read, Revillagigedo, and Wrangell islands (Heller 1909; Swarth 1911; Jackson 1928; UAM).

The occurrence of *Sorex cinereus* on Admiralty Island (Hall 1981) has been based on a single specimen collected during the 1907 Alexander Alaska Expedition (Heller 1909). This specimen (MVZ 68), recently examined by N. Dokuchaev and JAC, is a combination of *S. cinereus* skull with *S. monticolus* study skin. This mix-up, along with our failed efforts to turn up this shrew during extensive trapping efforts on the island, lead us to delete Admiralty Island as a valid locality for the species.

### *Sorex monticolus* Merriam, 1890, Dusky Shrew

*Sorex monticolus* occurs throughout Southeast Alaska's mainland and most of the islands of the Alexander Archipelago except, perhaps, Baranof and Chichagof islands. Hall (1981) recognized four subspecies (as *S. vagrans*) in Southeast Alaska: *alascensis* (type locality = Yakutat), *ellassodon*, *longicauda* (type locality = Wrangell) and *malitiosus* (type locality = east side of Warren Island). Dusky Shrew populations from the head of Lynn Canal were recognized as *S. [m]. obscurus* (Jackson 1928; Hennings and Hoffmann 1977; Antell 1987).

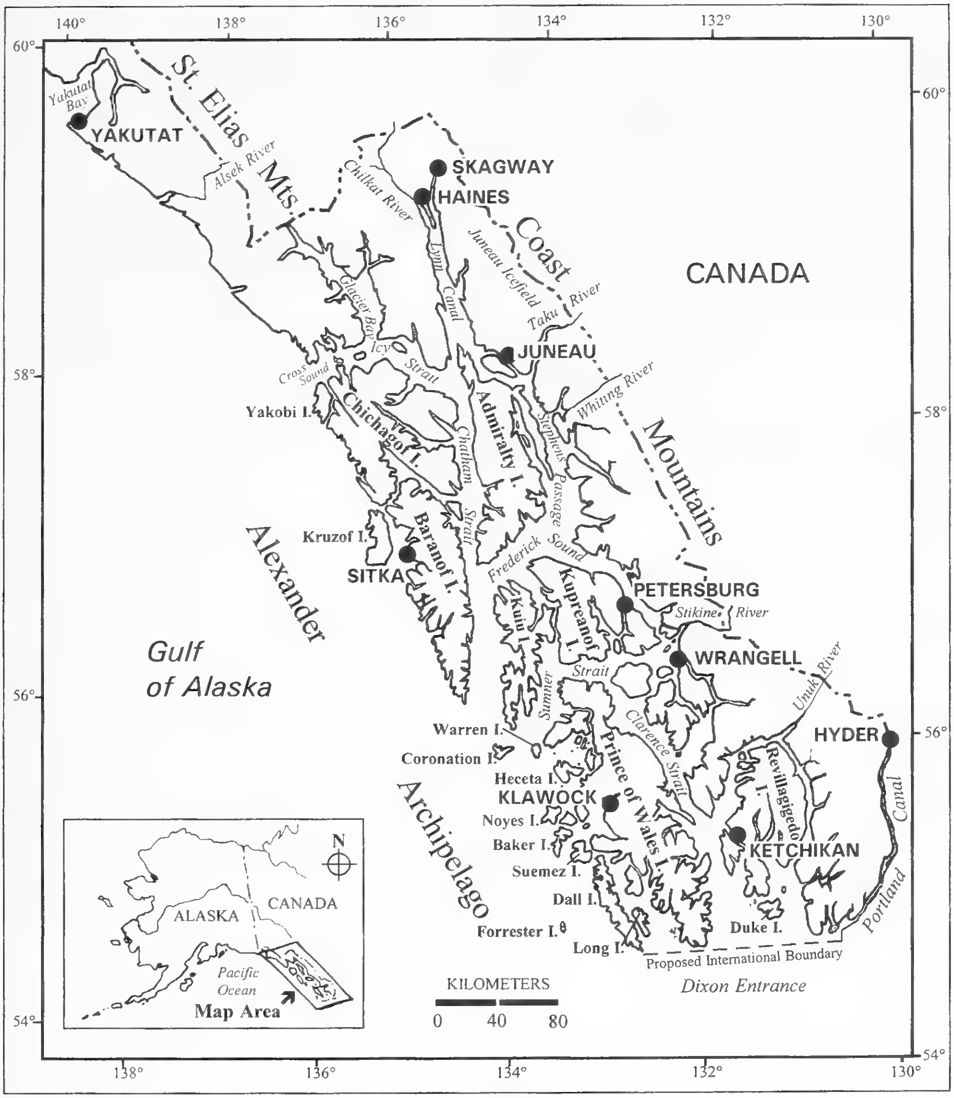


Figure 1. Map of Southeast Alaska and the Alexander Archipelago. Latitudinal and longitudinal coordinates for all islands identified in the species accounts are reported in Table 1.

Specimens of this species have been collected along the mainland from Yakutat to Portland Canal (Swarth 1911; Jackson 1928; Hennings and Hoffmann 1977; UAM), and from the following islands: Admiralty, Anguilla, Back, Baker, Barrier, Bell, Betton, Black, Cap, Cat, Coronation, Dall, Douglas, Duke, Eagle, Etolin, Forrester, Gedney, Gravina, Hassler, Heceta, Hoot, Inian, Kadin, Kuiu, Kupreanof, Lemesurier, Long, Lowrie, Lulu, Marble, Mary, Mitkof, Noyes, Owl, Pleasant, Prince of Wales, Revillagigedo, San, San Fernando, Sangeo, Shrubby, Sukkwan, Sullivan, Suemez, Tuxekan, Vank, Warren, Woewodski, Woronkofski, Wrangell, and Zarembo (Heller 1909; Swarth 1911; Jackson 1919, 1928; McGregor 1958; Harris 1968; Hennings and Hoffmann 1977; UAM). Swarth (1911) reported specimens from Shakan, which is on Kosciusko Island, but it remains unclear if he meant nearby on Prince of Wales Island (Hall 1981).

The occurrence of *S. monticolus* on two major islands in the Alexander Archipelago remains controversial. A specimen identified as this species from Baranof Island was reported by Hall (1981, as *S. vagrans elassodon*) in reference to Jackson (1928: 131). Jackson's (1928) record is a skin without skull (USNM 0238296). Subsequent collecting efforts on Baranof Island have documented only *S. cinereus*. Most shrew species are difficult to distinguish with

TABLE 1. Five biogeographic subregions for Southeast Alaska, including the islands and mammals that occur in each subregion. Subregions are based on unique combinations of taxa and presence of endemic taxa (bold).

| SUBREGION | ISLANDS WITH KNOWN RECORDS | MAMMAL TAXA PRESENT |
|---|---|---|
| 1. MAINLAND | **Douglas** (58° 15′N, 134° 16′W), **Dry** (56° 39′N, 132° 30′W), **Farm** (56° 38′N, 132° 25′W), **Pleasant** (58° 21′N, 135° 38′W), **Read** (57° 07′N, 133° 11′W), **Sullivan** (58° 53′N, 135° 19′W) | *Sorex cinereus, S. monticolus, S. palustris, S. alaskanus, Myotis lucifugus, Lasionycteris noctivagans, Ochotona collaris, Lepus americanus, Marmota caligata,* ***M. c. vigilis****, Spermophilus parryii, Tamiasciurus hudsonicus, Glaucomys sabrinus, Castor canadensis, Peromyscus keeni, Neotoma cinerea, Clethrionomys rutilus,* ***C. r. glacialis****,* ***C. gapperi stikinensis****,* ***C. g. wrangeli****, Microtus pennsylvanicus, M. oeconomus, M. o. yakutatensis, M. longicaudus, Ondatra zibethicus, Synaptomys borealis, Zapus hudsonius, Z. princeps, Erethizon dorsatum, Canis latrans, C. lupus, Vulpes vulpes, Ursus americanus, U. arctos, Martes americana, M. pennanti, Mustela erminea,* ***M. e. alascensis****, M. nivalis, M. vison, Gulo gulo, Lontra canadensis, Puma concolor, Lynx canadensis, Odocoileus hemionus, Alces alces, Rangifer tarandus, Ovis dalli, Oreamnos americanus* |
| 2. MIDDLE & SOUTHERN INNER ISLANDS | **Annette** (55° 09′N, 131° 28′W), **Back** (55° 32′N, 131° 45′W), **Bell** (55° 57′N, 131° 30′W), **Betton** (55° 31′N, 131° 48′W), **Black** (55° 54′N, 131° 40′W), **Butterworth** (56° 32′N, 133° 04′W), **Castle Is.** (56° 40′N, 133° 10′W), **Conclusion** (56° 29′N, 133° 49′W), **Etolin** (56° 06′N, 132° 21′W), **Fair** (56° 35′N, 133° 03′W), **Gedney** (55° 51′N, 131° 41′W), **Grant** (55° 33′N, 131° 43′W), **Gravina** (55° 17′N, 131° 46′W), **Grief** (56° 37′N, 133° 04′W), **Halleck** (57° 13′N, 135° 27′W), **Hassler** (55° 53′N, 38° 16′W), **Kadin** (56° 32′N, 132° 27′W), **Keene** (56° 36′N, 132° 59′W), **Kuiu** (56° 35′N, 134° 00′W), **Kupreanof** (56° 45′N, 133° 30′W), **Mitkof** (56° 40′N, 132° 50′W), **Revillagigedo** (55° 35′N, 131° 20′W), **Sokolof** (56° 30′N, 132° 35′W), **Tatoosh Is.** (55° 31′N, 131° 50′W), **Tongass** (54° 46′N, 130° 14′W), **Vank** (56° 28′N, 132° 36′W), **Woewodski** (56° 34′N, 133° 00′W), **Woronkofski** (56° 23′N, 133° 30′W), **Wrangell** (56° 16′N, 132° 12′W) | *Sorex cinereus, S. monticolus, Myotis lucifugus, M. keenii, M. volans, Lasionycteris noctivagans, Tamiasciurus hudsonicus, Glaucomys sabrinus, Castor canadensis, Peromyscus keeni,* ***Clethrionomys gapperi solus****, Microtus pennsylvanicus, M. longicaudus, Ondatra zibethicus, Zapus hudsonius, Erethizon dorsatum, Canis lupus, Ursus americanus, Martes americana, Mustela erminea, M. vison, Gulo gulo, Lontra canadensis, Odocoileus hemionus, Alces alces* |
| 3. SOUTHERN OUTHER ISLANDS | **Anguilla** (55° 40′N, 133° 35′W), **Baker** (55° 22′N, 133° 36′W), **Barrier Is.** (54° 48′N, 132° 25′W), **Cap** (55° 53′N, 133° 22′W), **Cat** (55° 01′N, 131° 15′W), **Cone** (55° 26′N, 133° 38′W), **Coronation** (55° 53′N, 134° 14′W), **Dall** (54° 57′N, 133° 00′W), **Duck Is.** (54° 59′N, 131° 14′W), **Duke** (54° 55′N, 131° 20′W), **Eagle** (55° 53′N, 133° 30′W), **El Capitan** (55° 55′N, 133° 20′W), **Esquibel** (55° 38′N, 133° 35′W), **Forrester** (54° 48′N, 133° 31′W), **Heceta** (55° 45′N, 133° 30′W), **Hoot** (55° 53′N, 133° 23′W), **Kosciusko** (56° 03′N, 133° 33′W), **Long** (54° 51′N, 132° 41′W), **Lulu** (55° 28′N, 133° 30′W), **Marble** (55° 58′N, 133° 27′W), **Mary** (55° 05′N, 131° 12′W), **Noyes** (55° 30′N, 133° 40′W),, **Orr** (55° 57′N, 133° 24′W), **Owl** (55° 53′N, 133° 25′W), **Prince of Wales** (55° 21′N, 133° 36′W), **San** (55° 56′N, 133° 21′W), **San Fernando** (55° 30′N, 133° 20′W), **Sangao** (55° 00′N, 133° 17′W), **Santa Rita** (55° 25′N, 133° 27′W), **Shrubby** (56° 13′N, 132° 58′W), **Stevenson** (56° 02′N, 132° 57′W), **Suemez** (55° 16′N, 133° 21′W), **Sukkwan** (55° 06′N, 132° 46′W), **Tuxekan** (55° 51′N, 133° 17′W), **Warren** (55° 53′N, 133° 53′W), **Zarembo** (56° 20′N, 132° 50′W) | *Sorex monticolus,* ***S. m. malitiosus****, Myotis lucifugus, M. keenii, M. californicus, Tamiasciurus hudsonicus* (Zarembo I, only), ***Glaucomys sabrinus griseifrons****, Castor canadensis, Peromyscus keenii,* ***P. k. oceanicus****, Microtus longicaudus,* ***M. coronarius****, Canis lupus, Ursus americanus,* ***Mustela erminea celenda****,* ***M. e. seclusa****, M. vison, Lontra canadensis, Odocoileus hemionus* |

*(Continued)*

TABLE 1. *(Concluded)*

| SUBREGION | ISLANDS WITH KNOWN RECORDS | MAMMAL TAXA PRESENT |
|---|---|---|
| 4. NORTHERN INNER ISLANDS | **Admiralty** (57° 40'N, 134° 20'W), **The Brothers** (57° 18'N, 133° 50'W), **Swan** (57° 56'N, 134° 14'W), | *Sorex monticolus, Myotis lucifugus, M. volans,* ***Castor canadensis phaeus*** *Peromyscus keeni,* ***Microtus pennsylvanicus admiraltiae****, Microtus longicaudus, Ondatra zibethicus, Ursus arctos, Martes americana,* ***Mustela erminea salva****, M. vison, Lontra canadensis, Odocoileus hemionus* |
| 5. NORTHERN OUTER ISLANDS | **Baranof** (56° 45'N, 135° 10'W), **Catherine** (57° 22'N, 134° 53'W), **Chichagof** (57° 30'N, 135° 30'W), **Inian Is.** (58° 15'N, 134° 16'W), **Krestof** (58° 15'N, 134° 16'W), **Kruzof** (58° 15'N, 134° 16'W), **Lemesurier** (58° 17'N, 136° 05'W), **Lowrie** (54° 51'N, 133° 32'W), **Moser** (57° 41'N, 135° 40'W), **Myriad Is.** (57° 38'N, 136° 13'W), **Otstoia** (57° 33'N, 135° 26'W), **Partofshikof** (57° 15'N, 135° 36'W), **Yakobi** (57° 56'N, 136° 27'W) | *Sorex cinereus, Myotis lucifugus, M. keenii, Castor canadensis, Peromyscus keeni,* ***Microtus oeconomus sitkensis****, M. longicaudus, Ursus arctos,* ***Mustela erminea initis****, M. vison, Lontra canadensis, Odocoileus hemionus* |

certainty when only the study skin is available. Jackson's (1928) specimen may actually have been *S. cinereus*. Heller (1909: 263) stated that *S. monticolus* was 'known to occur on Chichagof Island'; however, we have not been able to confirm this.

*Sorex palustris* Richardson, 1828, Water Shrew

The distribution of *Sorex palustris* in Southeast Alaska is poorly documented. The few published records (all mainland localities) are the Chilkat River near Haines (Jackson 1928; Baker 1951; MacDonald and Elliot 1984; KU; USNM), Rudyerd (*sic*) Bay, Behm Canal (Swarth 1922; UCLA), Salmon River and Texas Creek near Hyder (UAM), Farm Island (UAM), Stikine River (UAM), and Thomas Bay (UAM), suggesting that this species, while occurring widely along the coastal mainland, is highly localized and rarely encountered.

*Sorex alaskanus* Merriam, 1900,
Glacier Bay Water Shrew

The only published Glacier Bay Water Shrew record is that of two males (USNM 97712, 97713) taken on 12 June 1899 by A. K. Fisher from Point Gustavus (type locality) and described as a new subspecies, *S. navigator (= palustris) alaskanus* by Merriam (1900). The subsequent elevation of these two specimens to full species status, *S. alaskanus*, by Jackson (1926, 1928) has been questioned by Hall (1981) and Junge and Hoffmann (1981; but see Hutterer 1993; Carraway 1995). One additional specimen of *S. alaskanus* was collected from Bartlett Cove and is housed in the collection at Glacier Bay National Park (GBNP) at Bartlett Cove. The taxonomy and distribution of *S. alaskanus* needs clarification because it is represented by only three specimens.

*Myotis lucifugus* (Le Conte, 1831),
Little Brown Myotis

The distribution and occurrence of all bat species are poorly documented in Southeast Alaska, although several species apparently reach their northern range limits in this region (Hall 1981).

The Little Brown Myotis is undoubtedly the most numerous and widely distributed bat in Southeast Alaska. Although small bats are often seen throughout the region, relatively few specimens substantiate this assumption. Sitka is the type locality for *M. l. alascensis* (Miller 1897). Another subspecies, *M. l. pernox*, may occur in the upper Lynn Canal region, westward (inferred from Hall 1981).

Records from the mainland include those from the Hyder area, Boca de Quadra, Chickamin River, and the Stikine River (Swarth 1911, UAM). Records from islands are from Admiralty, Baranof, Chichagof, Mitkof, Prince of Wales, Revillagigedo, and Wrangell islands (Streator 1895*; Heller 1909; Swarth 1911; UAM).

*Myotis keenii* (Merriam, 1895), Keen's Myotis

The occurrence of *Myotis keenii* in Southeast Alaska has been based on one record from Wrangell, Wrangell Island (Miller 1897; Anderson 1946). The identity of this specimen, which is housed at the USNM, was recently verified (van Zyll de Jong and Nagorsen 1994). A second and third specimen of Keen's Myotis were collected in 1993 at Turn Creek, Prince of Wales Island (UAM 23338, male) and at Hoonah, Chichagof Island on 11 July 1994 (UAM 29831, male). The latter came from a maternity roost of *M. lucifugus* (Parker and Cook 1996).

The biology of this species is poorly known and the species is represented by some 59 specimens in museum collections (van Zyll de Jong and Nagorsen 1994). Whether this is an indication that this species is actually rare, and thus a species of concern for conservation, is unknown. Nagorsen and Brigham (1993) suggest that so little information is currently available on this species that little can be said about its habitat affinities. No subspecies are currently recognized (van Zyll de Jong 1985).

*Myotis volans* (H. Allen, 1866), Long-legged Myotis

For over 80 years, a single specimen of *Myotis volans* (MVZ 186) was the only record of this species in Alaska. It was collected by C. Littlejohn on 9 June 1907 at Mole Harbor, Admiralty Island (Miller and Allen 1928). Recently, three specimens from Wrangell Island (UAM 19756, 19757; ADF&G location unknown) and one specimen from Prince of Wales Island (UAM 24822) were recorded (West 1994; Parker et al. *in preparation**). The original Admiralty Island record was included under the subspecies *M. v. longicrus* (Hall 1981).

*Myotis californicus* (Audubon & Bachman, 1842), California Myotis

Miller and Allen (1928) reported two specimens of *Myotis californicus* from Howkan, Long Island. Recently (Parker et al. *in preparation**), two *M. californicus* skulls were discovered in El Capitan Cave on Prince of Wales Island (UAM 22143, 22144). A third live animal was collected there in February 1992 (UAM 20498). The Alaska specimens have been included under the subspecies *M. c. caurinus*.

*Lasionycteris noctivagans* (Le Conte, 1831), Silver-haired Bat

This species was known for Southeast Alaska from one specimen (AMNH 213141), a juvenile female found roosting on 4 November 1964 in an old gill net hanging in a shed on Canyon Island, Taku River (Barbour and Davis 1969).

Three recent specimens (Parker et al. *in preparation**), all collected in January, include a specimen (UAM 20738) found in a woodpile 15 km south of Wrangell, a specimen (UAM 30100) found dead clinging to the side of a house in Petersburg, and a specimen (UAM 30099) found alive in a house entryway in Ketchikan.

*Eptesicus fuscus* (Beauvois, 1796), Big Brown Bat

Manville and Young (1965) and Barbour and Davis (1969) suggest the occurrence of *Eptesicus* in Southeast Alaska, presumably in the vicinity of Juneau, but we have not been able to confirm this. We are sure of only one Alaska record, that reported by Reeder (1965) from Shaw Creek, west of Delta Junction in central Alaska. There are no known records of this species anywhere near Southeast Alaska in British Columbia (Nagorsen and Brigham 1993).

*Ochotona collaris* (Nelson, 1893), Collared Pika

The Collared Pika is known in Southeast Alaska from only White Pass, at the alpine border of Alaska and British Columbia (Osgood 1900; UAM). This species may be present in other mountain areas of the relatively unexplored mainland, particularly in the Haines and Skagway area.

*Lepus americanus* Erxleben, 1777, Snowshoe Hare

Snowshoe Hares have a very limited northern mainland distribution in Southeast Alaska occurring in the Chilkat Valley near Haines, and at Dyea in the vicinity of Skagway (Streator 1895*; Bailey 1920*; Jewett 1941*; UAM; MVZ). Hares are occasionally found in the Taku River valley toward the Canada border (Streator 1895*; J. Owens personal communication 1994). Home (1973*) reported sightings of hares at Glacier Bay and on the Alsek River. A report of hares at the mouth of the Stikine River (Manville and Young 1965) has not been substantiated.

Snowshoe Hares now present on Douglas Island were introduced there from Haines stock "a few years previous" (Bailey 1920*; also Wenrich 1922*). The hares on the mainland near Juneau were most likely derived from these animals.

In 1923 and 1924, the Alaska Game Commission released Snowshoe Hares from Washington stock to Pt. Retreat, Admiralty Island; Otstoia Island, Peril Strait; and Smeaton Island, Behm Canal. Stock from the Anchorage area were also released in 1924 on Cape Island, Prince of Wales Island; and, on Village Island, Zimovia Strait. All these transplant attempts were considered failures (Burris and McKnight 1973).

*Oryctolagus cuniculus* (Linnaeus, 1758), European or Domestic Rabbit

Several residents of Ketchikan have reported (in 1995) the presence of feral rabbits on Betton Island, Clover Pass. Their current status is unknown.

*Reference in Document Cited section.

*Marmota caligata* (Eschscholtz, 1829), Hoary Marmot

The Hoary Marmot occurs throughout Southeast Alaska's mainland coast (tide water up to alpine), with reports from Yakutat, Glacier Bay, White Pass, Juneau area, Taku River, Port Snettisham, Swan Lake, Chickamin River, Boca de Quadra, and Hyder (Osgood 1900; Heller 1909; Swarth 1911; Howell 1915; Hoffmann et al. 1979; UAM). Anderson (1946) and Dufresne (1946) both mention Hoary Marmots along Portland Canal. Specimens collected close to the mainland in 1992 and 1995 on Douglas Island are the only island records for this species in Southeast Alaska.

Marmots at Glacier Bay are considered an endemic subspecies, *M. c. vigilis* (Heller 1909; Howell 1915). All others in Southeast Alaska are included under the name *M. c. caligata* (Hall 1981). Marmots from Juneau were transplanted to the Klawock area, Prince of Wales Island, in 1930 by the Alaska Game Commission (Burris and McKnight 1973). Their present status is unknown.

Of biogeographic interest was the discovery in 1992 of a fossil marmot incisor, dated at > 44 500 yr B.P., and a marmot molar from the same locality in 1994 in a cave on Prince of Wales Island (Heaton 1995).

*Spermophilus parryii* (Richardson, 1825), Arctic Ground Squirrel

The Arctic Ground Squirrel is a Holarctic species with a limited distribution in Southeast Alaska. Its known occurrence there is currently restricted to the coastal mountains north of Skagway (Osgood 1900; UAM). The type locality of that subspecies, *S. p. plesius*, is Lake Bennett, British Columbia, not far from the Alaska border (Osgood 1900; Howell 1938). As with *Ochotona collaris* and several other alpine species, further inventory work in the relatively unexplored mountains along the region's mainland may change our understanding of the distribution of this species.

*Tamiasciurus hudsonicus* (Erxleben, 1777), Red Squirrel

*Tamiasciurus hudsonicus* is found in suitable forest habitats throughout the mainland of Southeast Alaska (including Douglas Island) and, before the days of game transplanting, on those islands in the Alexander Archipelago south of Frederick Sound and east of Clarence Strait, including Annette, Betton, Etolin, Gedney, Grant, Gravina, Hassler, Kuiu, Kupreanof, Mitkof, Read, Revillagigedo, Sullivan, Tatoosh, Tongass, Vank, Woewodski, Woronkofski, Wrangell, and Zarembo islands. (Osgood 1900; Heller 1909; Swarth 1911, 1921, 1922; KU; MVZ; UAM; UAM sight records).

Squirrels from Glacier Bay to Glacier and White Pass north of Skagway were designated *T. h. petulans* by Osgood (1900) (type locality = White Pass, southern Alaska). From Lynn Canal south, Swarth (1921) considered them a different subspecies, *T. h. picatus* (type locality = Kupreanof Island, 25 mi. south of Kake Village, at southern end of Keku Straits).

The status of the Red Squirrel as a native resident of Admiralty Island is unclear. Neither Heller (1909) nor Swarth (1921) indicated their presence on this island. Dufresne (1946), however, claimed that the Red Squirrel was indigenous to Admiralty Island. Burris and McKnight (1973) indicated that this animal is "scarce or nonexistent" there. Most evidence suggests that this species was introduced to the north end of the island since the late 1940s or early 1950s. In 1993, the Red Squirrel was reported for the first time as far south as Angoon (R. Carstensen, personal communication 1994). In 1995, a specimen was taken at Hood Bay (UAM).

Red Squirrels from the Juneau area were successfully transplanted to Baranof and Chichagof islands in 1930 and 1931 (Burris and McKnight 1973). Since then, Red Squirrels have been found on Inian, Kruzof, Moser, Partofshikof, Yakobi islands, and on islands in Sitka Sound (UAM; L. Johnson, personal communication, 1994). An apparently unsuccessful transplant occurred on Prince of Wales Island (Fay and Sease 1985*).

*Glaucomys sabrinus* (Shaw, 1801), Northern Flying Squirrel

The distribution in Southeast Alaska of this squirrel of mature-forest habitats is poorly understood and specimen records are few. Flying squirrels are known from the mainland in the Glacier Bay area, near Haines, Chilkoot Inlet, Taiya River, Taku River, Bradfield Canal, and the Cleveland Peninsula and in the Alexander Archipelago from the Barrier Islands (off SW Prince of Wales Island), Betton Island (trapper report), El Capitan Island, Etolin Island, Kosciusko Island (sight record by local resident), Mitkof Island, Prince of Wales Island, Revillagigedo Island, Tuxekan Island, and Wrangell Island (Streator 1895*; Osgood 1900, 1905; Swarth 1911; Walker 1920*; Howell 1934; Fay and Sease 1985*; GBNP; MVZ; UAM).

Helm Bay, Cleveland Peninsula, is the type locality for *G. s. zaphaeus* (Osgood 1905). Flying squirrel populations restricted to Prince of Wales Island are currently recognized as an endemic subspecies, *G. s. griseifrons*. Manville and Young (1965) cite reports of *G. s. alpinus* six and nine miles north of Juneau. As is the case with much of the original taxonomic work on the mammals of Southeast Alaska, the description of *G. s. griseifrons* is based on few specimens (Howell 1934). However, preliminary analysis of MtDNA sequence data is revealing fixed basepair differences between subspecies (J. Demboski, personal communication 1995). Given the projected timber harvests on Prince of Wales and adjacent

islands in the next ten years, the status of this subspecies needs immediate review.

### *Castor canadensis* Kuhl, 1820, Beaver

Beaver occur today in suitable habitat along the mainland and on most of the islands of Southeast Alaska, except perhaps Coronation, Warren, Forrester and other small, remote islands. They are especially abundant along the major rivers of the mainland. Around the turn of this century heavy trapping pressures temporarily reduced or eliminated Beaver from a number of localities (Gray 1915*; Bailey 1920*).

Preserved specimens of Beaver from Southeast Alaska are few. In 1915, Gray noted Beaver were then absent from Etolin, Wrangell and the smaller islands in that area. Heller (1909) reported very old signs of beaver on Chichagof Island. Gary (1915*) was told that Beaver had previously occurred on Chichagof and Baranof islands. In a 1922 Game Condition report, W. Wenrich (1922*) commented, "It was said that at one time beaver were numerous [on Chichagof I.], but for some reason or other there are none left now."

Ten animals from Prince of Wales Island were successfully "re-introduced" to Baranof Island in 1927 (Burris and McKnight 1973). It remains unclear if Beaver were introduced to Kruzof Island in 1925 (Burris and McKnight 1973).

Heller (1909) described, based on six specimens (three adult), the endemic subspecies, *C. c. phaeus* (type locality = Pleasant Bay) from Admiralty Island and, presumably Chichagof and Baranof islands as well. All others are considered *C. c. belugae* (Hall 1981). A revision of Beaver in Southeast Alaska with adequate specimens and modern techniques is very much needed (Hafner et al. *in press*).

### *Peromyscus keeni* (Rhoads, 1894), Keen's Mouse

Keen's Mouse (formerly *P. maniculatus* and *P. sitkensis*; Hogan et al. 1993) is widely distributed throughout Southeast Alaska. This species occurs on the mainland at Glacier Bay from Tlingit Point and Muir Inlet (Home 1973*; USNM) eastward to Haines and Skagway southward (Osgood 1900; Heller 1909; Swarth 1911; MVZ; UAM; USNM). In the Alexander Archipelago it is known to occur on the following islands: Admiralty, Anguilla, Annette, Baker, Baranof, Betton, Brothers (East and West), Cat, Chichagof, Cone, Coronation, Dall, Douglas, Duke, Esquibel, Etolin, Forrester, Gravina, Heceta, Inian ("Big"), Kosciusko (Swarth 1911: 156, Figure 3), Kruzof, Kuiu, Kupreanof, Long, Lowrie, Lulu, Marble, Mary, Mitkof, Moser, Noyes, Orr, Partofshikof, Prince of Wales, Revillagigedo, San Fernando, Santa Rita, Shrubby, Swan, Suemez, Sukkwan, Tuxekan, Vank, Warren, Woewodski, Woronkofski, Wrangell, Yakobi, and Zarembo islands (Heller 1909; Osgood 1909; Swarth 1911; McGregor 1958; Harris 1968; Van Horne 1981; KU; MVZ; UAM; USNM).

Two species and five subspecies of *Peromyscus* were once recognized in this region (Hall 1981). Recently, Hogan et al. (1993) found chromosome, allozyme, and mitochondrial DNA variation supporting the hypothesis that Southeast Alaska subspecies of *P. maniculatus* and *P. sitkensis* are conspecific. They included them under *P. keeni*, which was recognized as the senior synonym. Currently described subspecies for the region (after Hall 1981) include *P. k. algidus*, *P. k. macrorhinus*, *P. k. hylaeus* (type locality = Hollis, Kasaan Bay, Prince of Wales Island; Osgood 1908), *P. k. oceanicus* (type locality = Forrester Island), and *P. k. sitkensis* (type locality = Sitka, Baranof Island). These are in need of revision.

Several pelage variants have been collected in Southeast Alaska. Of the adult specimens collected on San Fernando Island, 21 (67%) have partially or entirely brown venters. Two specimens on Shrubby Island and one on Etolin Island exhibited Horner's black mutation (Conroy et al. 1993*).

### *Neotoma cinerea* (Ord, 1815), Bushy-tailed Woodrat

The only published specimen records of *Neotoma cinerea* in this region are those reported by Shaw (1962) from the Taku River (specimen collected in 1940) and the Unuk River (1925). A woodrat collected at the head of Lake Bennett, British Columbia, and one seen at Glacier inside Alaska (Osgood 1900) indicate a mainland Alaska distribution at least this far north.

Specimens have been taken on nunataks in the Juneau Ice Fields (UPS). Dufresne (1946: 138-139) stated that woodrats were "fairly common near the head of Portland Canal and along the Unuk River. It has also been reported from the Stikine and Taku River watersheds." Hall (1981), in agreement with Cowan and Guiguet (1965) and Youngman (1975), placed Alaska woodrats under the subspecies *N. c. occidentalis*.

### *Clethrionomys rutilus* (Pallas, 1779), Northern Red-backed Vole

*Clethrionomys rutilus* is currently believed to occur along the northern mainland of Southeast Alaska east and south to Juneau. UAM has recent specimens from Douglas Island, an island in close proximity to the mainland near Juneau. An unpublished revision of *Clethrionomys rutilus* by Antell (1987) extended the distribution of the subspecies *C. r. glacialis* to include all populations from Yakutat south to Bartlett Cove (type locality = Glacier Bay; Orr 1945). Populations in the Haines/Skagway area south to Juneau are included under the subspecies *C. r. dawsoni*.

### *Clethrionomys gapperi* (Vigors, 1830), Southern Red-backed Vole

*Clethrionomys gapperi* is believed to inhabit the mainland of Southeast Alaska south of Juneau and on a few islands south of Stikine Strait and east of

Clarence Strait, namely Bell, Black, Etolin, Hassler, Read, Revillagigedo, and Wrangell islands (Hall 1981; UAM). Swarth (1922) reported *C. rutilus* on the Stikine River in British Columbia, downstream as far as Dokdaon Creek. About 45 km further downriver at Flood Glacier, he encountered *Evotomys wrangeli* (= *Clethrionomys gapperi*).

Four subspecies have been recognized in this region (Hall and Cockrum 1952, 1953): *C. g. stikinensis* (Stikine River south from the Flood Glacier, but not including Sergief Island, south to Helm Bay, Cleveland Peninsula); *C. g. phaeus* (type locality = Boca de Quadra); *C. g. wrangeli* (type locality = Wrangell Island); and *C. g. solus* (type locality = Loring, Revillagigedo Island). A possible fifth subspecies is *C. g. saturatus*, from the upper Portland Canal region.

Interspecific and intraspecific taxonomic relationships of these species of *Clethrionomys* should be reviewed. Bee and Hall (1956) and Youngman (1975) considered them conspecific. More specimens are needed from areas of contact, specifically along the Stikine River, between Dokdaon Creek and Flood Glacier, and along Southeast's coastal mainland, from Haines south.

### *Microtus pennsylvanicus* (Ord, 1815), Meadow Vole

The Meadow Vole, *Microtus pennsylvanicus*, has a restricted distribution in Southeast Alaska, occurring along the mainland valleys of the Chilkat, Taku, and Stikine rivers (including Sergief Island [= "Browns Island"; USNM]); and on Admiralty, Mitkof, and Vank islands (Heller 1909; Dale 1940; Baker 1951; UAM). Dale (1940) and Hall (1981) define three subspecies of *Microtus pennsylvanicus* for Southeast Alaska: *M. p. admiraltiae* (Admiralty Island; type locality = Windfall Harbor), *M. p. alcorni* (mainland valleys of the Chilkat River), and *M. p. rubidus* (Taku and Stikine river valleys). An analysis of the species by Snell and Cunnison (1983) found no conspicuous groupings, suggesting that subspecific designations may be inappropriate.

The identification of a specimen of *M. pennsylvanicus* (as *M. drummondii*) reportedly taken at Fort Wrangell (= townsite of Wrangell, Wrangell Island) by Mrs. S. H. Young in 1887 (USNM 00190736) was confirmed by SOM; however, this species has not been taken anywhere on the island in subsequent collecting efforts.

### *Microtus oeconomus* (Pallas, 1776), Tundra Vole

The Tundra Vole inhabits the northern mainland of Southeast Alaska from Yakutat Bay south and east to Glacier Bay and White Pass in the vicinity of Skagway (Hall 1981; Antell 1987; UAM). This species also occurs on Baranof, Chichagof, and Lemesurier islands in the northwestern Alexander Archipelago (Merriam 1897; Heller 1909; UAM). Those islands mark the southern extent of the distribution of this species in North America.

A revision of this species by Antell (1987) did not corroborate an earlier revision by Paradiso and Manville (1961). Antell (1987) described a new subspecies, *M. o. littoralis*, for populations of Tundra Vole from Bartlett Cove northward along the coast (but not including the area immediately north of Yakutat Bay, which Antell considered *M. o. yakutatensis*; type locality = north shore of Yakutat Bay). Antell (1987) also concluded that populations of this species (previously included under *M. o. macfarlani*) from Haines Junction, Yukon, and in the vicinity of Skagway warrant recognition as a new, and as yet undescribed subspecies. Tundra Voles on Baranof and Chichagof islands, which were not analyzed by Antell (1987), are included in *M. o. sitkensis* (type locality = Sitka, Baranof Island).

### *Microtus longicaudus* (Merriam, 1888), Long-tailed Vole

The Long-tailed Vole, *Microtus longicaudus*, is widely distributed throughout Southeast Alaska. It occurs in suitable herbaceous habitat throughout the coastal mainland, and on islands of the Alexander Archipelago as follows: Admiralty, Anguilla, Chichagof, Dall, Etolin, Hoot, Kosciusko, Kuiu, Kupreanof, Marble, Mary, Mitkof, Moser, Noyes, Orr, Owl, Prince of Wales, Revillagigedo, Stevenson, Suemez, Sullivan, Sukkwan, Tuxekan, Wrangell, and Zarembo islands (Bailey 1900; Osgood 1900; Heller 1909; Swarth 1911, 1933; McGregor 1958; Harris 1968; Van Horne 1982; Antell 1987; MVZ; UAM; USNM). Swarth (1911) reported seeing vole runways, presumably of this species, on Annette Island. Similarly, UAM collectors (SOM and D. Pengilly, June 1983) observed runways on Santa Rita and Baker islands. It is curious that Long-tailed Voles have not been documented on Baranof Island, despite its close proximity to Chichagof Island populations.

Two subspecies have been recognized in this region: *M. l. littoralis* (type locality = "Shakan") and *M. l. vellerosus* (Hall 1981; Antell 1987).

### *Microtus coronarius* Swarth, 1911, Coronation Island Vole

*Microtus coronarius* was described as a distinct species by Swarth (1911) from specimens collected on Coronation (type locality = Egg Harbor), Warren and Forrester islands (Swarth 1933). This taxon may be a subspecies of the more widely distributed *M. longicaudus*. Swarth (1933) distinguished *M. coronarius* from *M. longicaudus* by its larger body size. However, large-bodied voles are not restricted to these three islands, as illustrated by voles (UAM) from other Southeast Alaska localities that fit into the range of body measurements of *M. coronarius* listed by Swarth (1911, 1933). The close relationship of *M. coronarius* to *M. longicaudus* was pointed out by Hall (1981: 809 and Map 457) and needs to be

examined further. Warren, Coronation, and Forrester island populations should be examined karyotypically. A molecular systematic study that includes specimens from throughout the geographic range of Long-tailed Voles would help clarify the relationship of *M. coronarius* and *M. longicaudus*. Such an analysis would provide insight into the significance of the extensive chromosomal variation reported for this species group (Judd and Cross 1980; Musser and Carleton 1993).

*Ondatra zibethicus* (Linnaeus, 1766), Muskrat

Muskrats have a limited distribution in Southeast Alaska. Locality records include Yakutat Bay, the Haines area, Taku River (trapper report), Stikine River, Admiralty Island, and Revillagigedo Island. (Swarth 1911; 1922; Bailey 1920*; Hall and Cockrum 1953; Burris and McKnight 1973; MVZ; UAM; USNM). Muskrats have been reported from Kuiu Island, Kupreanof Island, and Mitkof Island (S. Blatt personal communication 1994).

There were unsuccessful attempts in 1929 to transplant Muskrats from Haines to Klawock Lake, Prince of Wales Island (Burris and McKnight 1973).

*Synaptomys borealis* (Richardson, 1828), Northern Bog Lemming

Little is known about this species in Southeast Alaska. Specimens are few, being limited to mainland localities that include the Chilkat River, Taiya River, Turner Lake, Crescent Lake, Port Snettisham, Sumdum, Port Houghton, Thomas Bay, Stikine River, Anan Creek, Unuk River, Chickamin River, Quadra Lakes, and Foggy Bay (Howell 1927; UAM). The type locality for the Southeast Alaska subspecies, *S. b. truei*, is Wrangell, Wrangell Island (Howell 1927).

The only island records are from Wrangell on Wrangell Island (Merriam 1896; Howell 1927) and recently from estuarine meadows on Betton, Back, and Gravina islands (UAM), near Revillagigedo Island. The presence of bog lemmings at the latter three island localities suggest a high probability of this species occurring on Revillagigedo Island as well, although this has yet to be documented.

*Rattus norvegicus* (Berkenhout, 1769), Norway Rat

*Rattus norvegicus* is a commensal, non-native rat associated with urban areas. Preserved specimens are few and include specimens from Petersburg, Mitkof Island; Ketchikan, Revillagigedo Island; and Juneau on the mainland (USNM). They have been seen at the landfill near Sitka (by SOM in 1982), where they are very common at times (L. Johnson, personal communication 1994).

Hall (1981) listed one subspecies for North America, *R. n. norvegicus*. Nagorsen (1990) indicated that the taxonomy of North American populations is obscured by multiple introductions.

*Mus musculus* Linnaeus, 1758, House Mouse

Introduced from Europe, this mouse is commensal with man, inhabiting urban and agricultural areas, primarily. Information on its distribution in Southeast Alaska is nearly non existent and no preserved specimens are known. C. P. Streator, in his notes from Juneau in August 1895*, caught three *Mus* in the forest near town; he stated that this species was getting common.

The form inhabiting northern North America, including Alaska, was believed to be derived from the commensal race *M. m. domesticus* (Schwarz and Schwarz 1943). Variation among North American populations has not been studied. This subspecies is considered a distinct species by some (Marshall and Sage 1981).

*Zapus hudsonius* (Zimmermann, 1780), Meadow Jumping Mouse

Until recently, there were only three locality records for *Zapus hudsonius* in Southeast Alaska: Yakutat Bay, Chilkat River near Haines (Baker 1951; Hall 1981; UAM) and, surprisingly, a single pregnant female from Portage Cove, Revillagigedo Island (Swarth 1911), 480 km south of Haines. In 1993 and 1995, eight additional *Z. hudsonius* were collected on Revillagigedo Island: seven at Portage Cove and one at the head of Orchard Lake (UAM).

The type locality for the race in Southeast Alaska, *Z. h. alascensis*, is Yakutat Bay (Merriam 1897). The close morphologic similarity between *Z. hudsonius* and *Z. princeps*, coupled with the disjunct distribution exhibited by *Z. hudsonius* on Revillagigedo Island, suggests that the status and relationship of all jumping mice in this region need to be examined more closely.

*Zapus princeps* J. A. Allen, 1893, Western Jumping Mouse

The presence of *Z. princeps* in Southeast Alaska was based on one adult male jumping mouse captured by Swarth (1911) on the Taku River. The subspecies of *Z. princeps* in Southeast Alaska is *Z. p. saltator*, according to Krutzsch (1954). Jones (1981) considered this taxon to be indistinct from *Z. p. princeps*.

Jumping mice presumed to be this species from dental/cranial characters (Krutzsch 1954) have been collected (all UAM) at mainland sites as follows: Salmon River near Hyder; Gwent Cove, Portland Canal; Kirk Point, Foggy Bay; Wolf Cabin, Chickamin River; Unuk River; Farm Island, Stikine River; and near Canyon Island, Taku River.

*Erethizon dorsatum* (Linnaeus, 1758), Porcupine

Porcupines occur throughout the mainland of Southeast Alaska (including Douglas Island) and in the Alexander Archipelago south of Frederick Sound, including Etolin, Hassler, Kupreanof, Mitkof, Revillagigedo, and Wrangell islands (Swarth 1911; Webster 1949; Bailey 1971; Eglitis and Hennon

1986; UAM; L. Carson, personal communication 1994; M. Brown, personal communication 1994). Two subspecies have been recognized in Southeast Alaska: *E. d. myops* Merriam from the Glacier/White Pass region (Osgood 1900), and probably all populations west to Yakutat Bay (see Hall 1981); and *E. d. nigresens* from Lynn Canal southward (Hall 1981). Further information is needed to clarify the distribution of this species in the Alexander Archipelago.

*Canis latrans* Say, 1823, Coyote

The Coyote is an infrequent visitor to the river valleys along the southern mainland of Southeast Alaska and a probable resident in some areas along the mainland north from the Taku River. The only island record we are aware of is an adult female Coyote trapped on Mitkof Island near Dry Straits in the winter of 1983-1984 (C. Land, personal communication 1994).

To our knowledge, no specimens from Southeast Alaska have been preserved. A specimen reported from the Alsek River by J. A. Allen (1908; and given as an Alaska record by Hall 1981) was that of a "Coyote killed near Whitehorse, on the Alsek River, Alaska in February 1907." We have not been able to locate this specimen and are unsure of exactly where it was taken as Whitehorse is farther north on the Yukon River in Yukon.

*Canis lupus* Linnaeus, 1758, Wolf

The Wolf inhabits the entire mainland of Southeast Alaska and islands in the Alexander Archipelago south of Frederick Sound, excluding Coronation, Forrester and, undoubtedly, some of the other small, more isolated islands without an adequate prey base. We are unaware of any records of this species ever occurring on any of the islands north of Frederick Sound. Museum specimens (UAM, except as noted) from the Alexander Archipelago are as follows: Baker, Bell, Conclusion (USNM), Duck, Etolin, Grief, Keene, Kuiu, Kupreanof, Mitkof, Prince of Wales, Read, Revillagigedo, Suemez, Woewodski, Wrangell, and Zarembo islands.

The subspecies *C. l. ligoni* (type locality = head of Duncan Canal, Kupreanof Island) is restricted to Southeast Alaska (Hall 1981; Pederson 1982). Molecular genetic research is currently underway at the Institute of Arctic Biology, UAF, to examine the status of this taxon (G. Shields, personal communication 1994).

*Vulpes vulpes* (Linnaeus, 1758), Red Fox

The Red Fox is an infrequent visitor to the river valleys along the southern mainland, and a probable uncommon resident along the northern mainland from the Taku River, north. We know of no reports of this species occurring naturally on any island in the Alexander Archipelago. The only specimen record we are aware of is one in the MVZ from Yakutat. We have not been able to locate a supposedly preserved specimen of a male Red Fox found poisoned near Haines by E. P. Walker on 9 February 1914 (Field Catalog, USNM); he considered this species "fairly common" there. The fossil jaw of a Red Fox was recently discovered in a cave on Prince of Wales Island (J. Baichtal, personal communication).

Red Foxes were introduced for commercial reasons on Cleft, Dry, Kupreanof, Passage, and Sokoi islands between 1894 and 1929; none were successful (Bailey 1993).

The subspecies occurring in Southeast Alaska has not been identified (Hall 1981), but it may be *V. v. abietorum*, the subspecies found in nearby British Columbia.

*Alopex lagopus* (Linnaeus, 1758), Arctic Fox

Arctic Foxes ("blue" morph from the Aleutians and Pribilof islands) were commercially stocked on over 170 islands in the Alexander Archipelago of Southeast Alaska between 1899 through 1929 (Bailey 1993: 25-29, for a complete listing). The industry collapsed in the 1930s; no Arctic Foxes remain in the region.

*Ursus americanus* Pallas, 1780, Black Bear

The Black Bear occurs along the entire mainland coast of Southeast Alaska and on most of the islands in the Alexander Archipelago south of Frederick Sound. We are unaware of Black Bears on Warren, Coronation, or Forrester islands, or on any island north of Frederick Sound except Pleasant Island in Icy Strait (K. Rutledge, personal communication 1994).

Mid-Wisconsin and Late-Wisconsin/early Holocene fossil remains of Black Bear have been found in caves on Prince of Wales Island (Heaton and Grady 1992, 1993; Heaton 1995).

*Ursus americanus pugnax* (type locality = Rocky Bay, now Bobs Bay, Dall Island) is the subspecies currently recognized for most of Southeast Alaska (Hall 1981). *Ursus a. emmonsii* (type locality = St. Elias Alps, near Yakutat Bay) is a race that includes the "glacier bear" color morph and it occurs along the mainland from Lynn Canal west and north to Prince William Sound (Dufresne 1946; Hall 1981). A taxonomic revision is needed.

*Ursus arctos* Linnaeus, 1758, Brown Bear

Brown Bears occur along the entire coastal mainland of Southeast Alaska (especially along the major river systems; ADF&G 1973), and on most of the islands of the Alexander Archipelago north of Frederick Sound. Brown Bears are occasionally seen but have never become established on islands close to the mainland south of Frederick Sound, specifically Etolin, Mitkof, Revillagigedo, and Wrangell (Jewett 1941*; Klein 1965; S. Blatt, personal communication 1994; J. Gustafson, personal communication 1994).

Of biogeographic interest (Klein 1965) is the recent discovery of *U. arctos* skeletal remains in limestone caves on Prince of Wales Island (Heaton

TABLE 2. List of the Recent land mammals of Southeast Alaska, including the number of taxa (subspecies) and the number of these that are endemic to the region, number of museum specimens (museums searched are listed in *Methods and Materials*), number of islands of known occurrence, and their current conservation status.

| Mammal Species Of Southeast Alaska | Number Of Taxa/ Number Endemic | Number of Specimens (UAM + Other Museums) | Number of Islands of Known Occurrence (Native + Introduced | Conser-vation Status† |
|---|---|---|---|---|
| INSECTIVORA — Shrews | | | | |
| Soricidae | | | | |
| *Sorex cinereus*, Masked Shrew | 2 / 0 | 356 + 277 | 23 | — |
| *Sorex monticolus*, Dusky Shrew | 4 / 2 | 497 + 622 | 52 | — |
| *Sorex palustris*, Water Shrew | 1 / 0 | 9 + 4 | 0 | — |
| *Sorex alaskanus*, Glacier Bay Water Shrew | 1 / 1 | 0 + 3 | 0 | ESA-C |
| CHIROPTERA — Bats | | | | |
| Vespertilionidae | | | | |
| *Myotis lucifugus*, Little Brown Myotis | 2 / 0 | 85 + 28 | cosmopolitan | — |
| *Myotis keenii*, Keen's Myotis | 1 / 0 | 2 + 1 | 3 | B.C. Red List |
| *Myotis volans*, Long-legged Myotis | 1 / 0 | 2 + 1 | 2 | — |
| *Myotis californicus*, California Myotis | 1 / 0 | 3 + 4 | 2 | — |
| *Lasionycteris noctivagans*, Silver-haired Bat | 1 / 0 | 3 + 1 | 3 | — |
| LAGOMORPHA — Pikas and Hares | | | | |
| Ochotonidae | | | | |
| *Ochotona collaris*, Collared Pika | 1 / 0 | 2 + 0 | 0 | — |
| Leporidae | | | | |
| *Lepus americanus*, Snowshoe Hare | 1 / 0 | 0 + 5 | 0 + 1 | — |
| *Oryctolagus cuniculus*, Domestic Rabbit | 1 / 0 | 0 + 0 | 0 + 1 | non-native |
| RODENTIA — Rodents | | | | |
| Sciuridae | | | | |
| *Marmota caligata*, Hoary Marmot | 2 / 1 | 6 + 12 | 1 | IUCN-IK |
| *Spermophilus parryii*, Arctic Ground Squirrel | 1 / 0 | 2 + 5 | 0 | — |
| *Tamiasciurus hudsonicus*, Red Squirrel | 2 / 1 | 31 + 74 | 21+ 8 | — |
| *Glaucomys sabrinus*, N. Flying Squirrel | 2 / 1 | 46 + 12 | 12 | IUCN-IK |
| Castoridae | | | | |
| *Castor canadensis*, Beaver | 2 / 1 | 5 + 3 | cosmopolitan | IUCN-IK |
| Muridae | | | | |
| *Peromyscus keeni*, Keen's Mouse | 5 / 3 | 1350 + 783 | 51 | — |
| *Neotoma cinerea*, Bushy-tailed Woodrat | 1 / 0 | 0 + 7 | 0 | — |
| *Clethrionomys rutilus*, N. Red-backed Vole | 2 / 1 | 34 + 427 | 1 | — |
| *Clethrionomys gapperi*, S. Red-backed Vole | 4 / 4 | 154 + 189 | 7 | IUCN-IK |
| *Microtus pennsylvanicus*, Meadow Vole | 3 / 1 | 40 + 96 | 3 | IUCN-IK |
| *Microtus oeconomus*, Tundra Vole | 3 / 2 | 40 + 231 | 3 | IUCN-IK |
| *Microtus longicaudus*, Long-tailed Vole | 2 / 0 | 219 + 436 | 25 | — |
| *Microtus coronarius*, Coronation Island Vole | 1 / 1 | 20 + 29 | 3 | IUCN-IK |
| *Ondatra zibethicus*, Muskrat | 1 / 0 | 17 + 9 | 5? | — |
| *Synaptomys borealis*, N. Bog Lemming | 1 / 0 | 23 + 14 | 4 (5?) | — |
| *Rattus norvegicus*, Norway Rat | 1 / 0 | 0 + 6 | 0 + 3 | non-native |
| *Mus musculus*, House Mouse | 1 / 0 | 0 + 0 | 0 + ? | non-native |
| Dipodidae | | | | |
| *Zapus hudsonius*, Meadow Jumping Mouse | 1 / 0 | 26 + 37 | 1 | — |
| *Zapus princeps*, Western Jumping Mouse | 1 / 0 | 32 + 1 | 0 | — |
| Erethizontidae | | | | |
| *Erethizon dorsatum*, Porcupine | 2 / 0 | 2 + 14 | 7 | — |
| CARNIVORA — Carnivores | | | | |
| Canidae | | | | |
| *Canis latrans*, Coyote | 1 / 0 | 0 + 0 | 1 (vagrant) | — |
| *Canis lupus*, Wolf | 1 / 1 | 310 + 61 | Islands S. Frederick Sound | IUCN-V |

Table 2. *(Concluded)*

| Mammal Species Of Southeast Alaska | Number Of Taxa/ Number Endemic | Number of Specimens (UAM + Other Museums) | Number of Islands of Known Occurrence (Native + Introduced | Conservation Status† |
|---|---|---|---|---|
| Carnivora — Carnivores | | | | |
| Canidae | | | | |
| *Vulpes vulpes*, Red Fox | 1 / 0 | 0 + 1 | 0 | — |
| *Alopex lagopus*, Arctic Fox | — | 0 + 0 | 0 + 182 | non-native extripated |
| Ursidae | | | | |
| *Ursus americanus*, Black Bear | 2 / 1 | 2 + 213 | Islands S. of Frederick Sound | CITES-II ESA-C B.C. Blue List |
| *Ursus arctos*, Brown Bear | 3 / 2 (?) | 33 + 603 | Islands N. of Frederick Sound; vagrant S. | CITES-II |
| Procyonidae | | | | |
| *Procyon lotor*, Raccoon | — | 0 + 0 | 0+3 | non-native extripated |
| Mustelidae | | | | |
| *Martes americana*, Marten | 2 / 0 | 347 + 16 | 9 + 7 | — |
| *Martes pennanti*, Fisher | 1 / 0 | 1 + 0 | 0 | B.C. Blue List |
| *Mustela erminea*, Ermine | 6 / 5 | 10 + 73 | cosmopolitan | ESA-C |
| *Mustela nivalis*, Least Weasel | — | none | — | — |
| *Mustela vison*, Mink | 2 / 1 | 396 + 175 | cosmopolitan | — |
| *Gulo gulo*, Wolverine | 1 / 0 | 4 + 5 | 6 | CITES-II |
| *Lontra canadensis*, River Otter | 1 / 0 | 111 + 26 | cosmopolitan | CITES-II |
| Felidae | | | | |
| *Puma concolor*, Mountain Lion | 1 / 0 | 1 + 0 | 1 (vagrant) | CITES-II |
| *Lynx canadensis*, Canada Lynx | 1 / 0 | 1 + 2 | 0 | CITES-II |
| Artiodactyla — Ungulates | | | | |
| Cervidae | | | | |
| *Cervus elaphus*, Elk | 2 / 0 | 0 + 0 | 0 + 2 | non-native |
| *Odocoileus hemionus*, Mule Deer | 2 / 0 | 8 + 94 | cosmopolitan | — |
| *Alces alces*, Moose | 2 / 0 | 0 + 0 | 5 | — |
| *Rangifer tarandus*, Caribou | 1 / 0 | none | 0 | — |
| Bovidae | | | | |
| *Ovis dalli*, Dall's Sheep | 1 / 0 | 0 + 0 | 0 | — |
| *Oreamnos americanus*, Mountain Goat | 1 / 0 | 1 + 4 | 0 + 2 | — |

†Conservation status of these taxa: ESA — Endangered Species Act 1973 (United States Fish and Wildlife Service 1993); IUCN — International Union for the Conservation of Nature, Species Survival Committee (Hafner et al. *in press*; BC — British Columbia, Canada (1993) Red and Blue Lists (Harper et al. 1994); CITES — Convention on International Trade of Endangered Species, Appendix II.

1995), ranging in age from mid-Wisconsin (35 365 ± 800 yr BP) to early Holocene. This island is south of Frederick Sound, where today only Black Bears occur. Brown Bear bones were also recently found in cave deposits on Dall Island (S. Lewis, personal communication 1995).

Rausch (1963) included all of the 13 species names originally proposed for Southeast Alaska Brown Bears by Merriam (1918) under the trinomial, *U. a. horribilis*. Hall (1984) recognized three subspecies for the Southeast Alaska region: *U. a. dalli* (Yakutat Bay-Dry Bay), *U. a. sitkensis* (islands north of Frederick Sound, adjacent northern mainland), and *U. a. stikeenensis* (southern mainland, Canada, Washington). Recent studies of mitochondrial DNA variation (Cronin et al. 1991, Talbot and Shields 1996) indicate that Brown Bears on islands in the Alexander Archipelago are distinct from populations of *U. arctos* on the Southeast mainland and elsewhere in Alaska.

### *Procyon lotor* (Linnaeus, 1758), Raccoon

Raccoons are not native to Southeast Alaska. Natural populations occur as close as Kingcome Inlet,

and Vancouver Island and adjacent islands of coastal British Columbia, Canada; they have been introduced to the Queen Charlotte Islands (Nagorsen 1990).

Eight melanistic Raccoons from Indiana were released on Singa Island, Sea Otter Sound, in October 1941, spreading to nearby El Capitan and several other islands in this area (Scheffer 1947; Burris and McKnight 1973). Their current status is unknown; however, we know of no recent reports and consider them extirpated.

In 1950, Raccoons of unknown origin were released or escaped on Japonski Island near Sitka, with a few eventually spreading to nearby Baranof Island (Elkins and Nelson 1954; Burris and McKnight 1973). Individuals were occasionally seen around the dump at the Sitka airport on Japonski Island up until the early 1970s when the airport was extended and the dump covered. None have been reported in the Sitka area since (L. Johnson, personal communication 1994).

*Martes americana* (Turton, 1806), Marten

Marten inhabit forest habitats along the entire coastal mainland of Southeast Alaska and on islands in the Alexander Archipelago in close proximity to the mainland. Natural populations occur on Admiralty (but see below), Etolin, Gravina, Kuiu, Kupreanof, Mitkof, Revillagigedo, Woewodski, and Wrangell islands (Streator 1895*; Swarth 1911; Gray 1915*; Walker 1920*; Dufresne 1946; MVZ; UAM; USNM; S. Blatt, personal communication 1994; L. Carson, personal communication 1994).

R. W. Flynn (*in* Suring et al. 1992*) questioned the natural occurrence of Marten on Admiralty Island, suggesting that their presence there may be the result of an unreported transplant. If true, it would have been done prior to 1903, when W. H. Osgood and N. Hollister (1903*) of the Biological Survey reported that small numbers of Marten occurred on Admiralty Island. Heller (1909: 246) mentioned Marten on Admiralty Island, as did Bailey (1920*) and Cahalane (1940*). Dufresne (1946) stated that Marten were native to this island; however, Gray (1915*) stated they were not found there. Allen Hasselborg, a long-time resident of Admiralty Island, collected Marten specimens from the island in 1910 and 1913 (MVZ), and in 1915 (USNM).

Before game laws early this century, Marten numbers in the region were greatly reduced by overtrapping (Gray 1915*; Bailey 1920*; Wenrich 1922*).

In 1934, Marten from Behm Canal and Thomas Bay on the mainland were successfully introduced on Prince of Wales Island and Baranof Island. Between 1949 and 1952, Marten were successfully introduced on Chichagof Island with stock taken from Baranof Island, Revillagigedo Island, the Stikine River drainage, Wrangell Island, Mitkof Island, and near Anchorage (Elkins and Nelson 1954; Burris and McKnight 1973). In addition, UAM has records of Marten taken in the vicinity of Baranof Island from Kruzof Island, Otstoia Island, Catherine Island, and Yakobi Island. Undoubtedly, all were from undocumented transplants.

Clark et al. (1987) separated 14 subspecies of North American Marten into two groups: "americana" and "caurina." Hagmeier (1958) and Anderson (1970) have also assessed subspecific differentiation in the marten. According to Hall (1981), the mainland of Southeast Alaska is occupied by two subspecies of the "americana" group, *M. a. kenaiensis* north and west of Lynn Canal, and *M. a. actuosa* from northern Lynn Canal south to about Cleveland Peninsula; in the "caurina" group, *M. a. caurina* occurs on the mainland south of Cleveland Peninsula, while *M. a. nesophila* inhabits islands in the Alexander Archipelago (but not as outlined in Map 507) and the Queen Charlotte Islands, Canada. Giannico and Nagorsen (1989), in a recent revision, concluded that the subspecies *M. a. nesophila* should be applied only to Queen Charlotte Islands populations (but see Swarth 1911), and assigned Vancouver Island and coastal British Columbia Martens to *M. a. caurina*. They suggested that *M. a. caurina* and *M. a. americana* may intergrade in Southeast Alaska. Unfortunately, these authors were unaware that the specimens from Baranof and Chichagof islands that they examined came from transplanted stocks.

*Martes pennanti* (Erxleben, 1777), Fisher

The earliest report of this species in Southeast Alaska that we are aware of is that of Coues (1877), who stated that the Fisher's range includes the "southern panhandle of Alaska", and that he had examined some of these. This report was noted by Allen (1942), Anderson (1946), and Hall (1981). F. H. Gray, in a 1915 report on Southeast Alaska furbearing animals to the Bureau of Fisheries, stated: "Fishers are extending their range to the north. But one was even taken on the Stikine River before 1908. Several were taken the last three years from the boundary [of Alaska and British Columbia]. Tracks of this animal were seen not far from here [Wrangell] last winter." Even earlier, C. P. Streator wrote, in an 1895 summary report to the Biological Survey, "Mr. Chase, a furdealer here [Streator was writing from Loring, Revillagigedo Island], informs me that he has seen skins [of Fisher] that were taken in this region." Further light is shed by MacLeod (1950) from registered trapline information in adjacent British Columbia, where trappers reported capturing Fisher from the lower Iskut River, the Unuk River, and near Stewart. The occurrence of Fisher in Southeast Alaska has now been confirmed by a voucher specimen collected from the Taku River in 1994 (UAM 24716). This lends credence to the report of a Fisher seen in Southeast Alaska near the mouth of the Unuk River in the winter of 1958-59

(T. Wills, personal communication 1993), and another reportedly trapped at Point Agassiz in the 1950s (S. Geraghty, personal communication 1994). It appears that this species is an uncommon visitor or marginal resident along the mainland of the region, at least as far north as the Taku River.

*Mustela erminea* Linnaeus, 1758, Ermine

The Ermine is a Holarctic species widely distributed throughout Southeast Alaska. Islands where Ermine are documented to occur are as follows: Admiralty, Baranof, Chichagof, Dall, Etolin, Kruzof, Kuiu, Kupreanof (Swarth, 1911, described a Native trapper from Kuiu Island taking Ermine on the "Kake islands" [= Kuiu + Kupreanof islands]), Long, Mitkof, Prince of Wales (Fay and Sease, 1985, mention, with further detail, Ermine taken on some of the smaller island adjacent to Prince of Wales), Revillagigedo, Suemez (Fay and Sease, 1985, reported two Ermine trapped there, but not preserved, in 1981-82), Wrangell, and Zarembo islands (Heller 1909; Swarth 1911; Hall 1944; MVZ; UAM; USNM; L. Johnson, personal communication 1994).

Hall (1944, 1951) recognized six subspecies (five are endemic to the region): *Mustela erminea arctica* (Yakutat Bay and Glacier Bay), *M. e. alascensis* (type locality = Juneau), *M. e. initis* (type locality = Saook Bay, Baranof Island), *M. e. salva* (type locality = Mole Harbor, Admiralty Island), *M. e. celenda* (type locality = Kasaan Bay, Prince of Wales Island), and *M. e. seclusa* (type locality = Port Santa Cruz, Suemez Island). A taxonomic revision based on more specimens (e.g., *M. e. seclusa* is based on a single specimen) is needed.

*Mustela nivalis* Linnaeus, 1766, Least Weasel

An unpublished report (Home 1973*) includes a number of credible sightings of the Least Weasel in the Glacier Bay area. Although we are unaware of any specimens of this species taken in Southeast Alaska, we suspect that this species very likely does occur in places along the northern mainland of the region, but not nearly as extensively as suggested by ADF&G (Alaska Department of Fish and Game 1973).

*Mustela vison* Schreber, 1777, Mink

Mink are widely distributed throughout Southeast Alaska, occurring in close association with marine and fresh water ecosystems. Documented Mink records in the archipelago are far from complete, but include Admiralty, Anguilla, Baranof, Barrier islands, Butterworth, Castle, Chichagof, Coronation, Esquibel, Etolin, Kruzof, Kuiu, Kupreanof, Long, Mitkof, Myriad islands, Prince of Wales, Revillagigedo, Shrubby, Sitka Sound islands; Sokalof, Suemez, Tongass, Wrangell, and Zarembo (Heller 1909; Swarth 1911; Hollister 1913; MVZ, UAM; USNM; L. Johnson, personal communication 1994).

Two subspecies occur in the region (Hall 1981): *M. v. energumenos* and *M. v. nesolestes* (type locality = Windfall Harbor, Admiralty Island).

*Gulo gulo* (Linnaeus, 1758), Wolverine

Wolverines inhabit the mainland and occur as residents or vagrants on several islands in the Alexander Archipelago, specifically Fair, Kuiu, Kupreanof, Mitkof, Revillagigedo, and Wrangell islands (Webster 1949; MVZ; UAM; USNM; C. Land, personal communication 1992).

*Lontra canadensis* (Schreber, 1777), River Otter

The River Otter is found along the coastal and inland waters throughout Southeast Alaska. Specimens records are from a number of mainland localities and, in the Alexander Archipelago, from Admiralty, Baranof, Chichagof, Coronation, Dall, Gavanski, Halleck, Krestof, Kruzof, Kuiu, Kupreanof, Long, Marble, Prince of Wales, Rapids, Shrubby, Warren, Woronkofski, and Wrangell islands (van Zyll de Jong 1972; CMNH; MVZ; UAM; USNM).

*Lontra canadensis mira* (type locality = Kasaan Bay, Prince of Wales Island) is a subspecies endemic to Southeast Alaska and coastal British Columbia (Hall 1981) and was once considered a distinct species restricted to Prince of Wales and neighboring islands (Hall and Kelson 1959). Reviews of the taxonomic status of *Lontra canadensis* (formerly *Lutra canadensis*) indicated that River Otters from Southeast Alaska are morphologically distinct from other populations (van Zyll de Jong 1972; Fagen 1986).

*Puma concolor* (Linnaeus, 1771), Puma or Mountain Lion

The rare occurrence of this species in Southeast Alaska was substantiated by the collection of a male on the east side of Wrangell Island along Blake Channel opposite Aaron Creek, 25 November 1989 (UAM 18551). This area is close to the mainland. The animal may have arrived from British Columbia along the trans-coastal corridor of the Stikine River. Charlie Land, ADF&G, Petersburg (personal communication 1994), found no indication that this had been a captive animal.

Youngman (1975) documented six Puma sightings in Yukon, between 1955 and 1967. An increasing number of recent sightings have been reported to UAM of Pumas in Southeast Alaska (as well as in the Wrangell Mountains of east-central Alaska). Perhaps these mountain lions are expanding their range in relation to the recent westward expansion of Mule Deer into Yukon and east-central Alaska.

*Lynx canadensis* Kerr, 1792, Canada Lynx

Canada Lynx are uncommon residents from upper Lynn Canal north and westward, and occasional visitors elsewhere along the mainland of Southeast Alaska, occurring infrequently along the major river corridors. Gray (1915*) and Swarth (1936) suggest-

ed that when Snowshoe Hares become scarce in the interior of British Columbia, *L canadensis* are found more frequently in Southeast Alaska.

Preserved specimens from the region are limited to one from Yakutat (MVZ), one from Taku Inlet (USNM), and one found in the Hyder landfill (UAM), May 1995 (exact collection locality unknown). Greg Streveler (personal communication 1994) discovered the skeletal remains of a lynx in upper Muir Inlet of Glacier Bay in 1968; the location of that specimen, if preserved, is not known.

Bailey (1920*) reported seeing the carcasses of two lynx killed close to the mainland on Douglas Island (where Snowshoe Hares had been introduced), apparently the only island record of this species in Southeast Alaska.

### *Cervus elaphus* Linnaeus, 1758, Elk or Wapiti

Elk were members of Alaska's large mammal fauna into the early Holocene (Guthrie 1966); however, there is no evidence that they ever occurred in Southeast Alaska.

There have been a number of attempts to introduce Elk to Southeast Alaska (Burris and McKnight 1973), beginning in 1926 and 1927 with the release of seven animals (from the state of Washington) on Kruzof Island. Three attempts were made to introduce Elk to Revillagigedo Island: in 1937 (Washington stock), 1963, and 1964 (from the Afognak Island herd which was originally from Washington). Animals were also released on Gravina Island in 1962, and on Annette Island in 1963, and, like all of the previous attempts, failed.

In 1987, 50 Elk from Oregon were released on Etolin Island. By 1993, they had increased in number and had spread to nearby Zarembo Island and to adjacent areas, with sightings as far away as Cleveland Peninsula (J. Gustafson, personal communication 1994).

### *Odocoileus hemionus* (Rafinesque, 1817), Mule Deer

Sitka Black-tailed Deer, the most frequently used common name for this subspecies, are found throughout most of Southeast Alaska south of Cape Spencer. They are rare to non-existent along the mainland coast. Deer are strong swimmers and seem to have little trouble crossing wide expanses of coastal waters. As a result, they occur on nearly every island in the archipelago, except Forrester Island (Heath 1913*; Klein 1965).

According to Home (1973*), deer were unknown on the mainland from Cape Spencer to Yakutat (and westward to Prince William Sound) until they were transplanted to islands in Yakutat Bay in 1934 (from Rocky Pass stocks; Burris and McKnight 1973). Other transplants in the region included the Taiya Valley near Skagway in 1951, 1952, and 1956; and on Sullivan Island, Lynn Canal, in 1951-1954. Deer no longer occur in the Yakutat area, and transplants to Taiya River Valley and Sullivan Island eventually failed (L. Johnson, personal communication 1994).

The type locality for the Sitka Black-tailed Deer, *O. h. sitkensis*, is Sitka, Baranof Island (Hall 1981 as *Dama*). There is a report of one record of the larger interior subspecies, *O. h. hemionus*, taken from the Stikine River (Alaska Department of Fish and Game 1973).

### *Alces alces* (Linnaeus, 1758), Moose

Since early this century, Moose have been expanding their range into Southeast Alaska (Klein 1965), first establishing breeding populations along the major mainland river valleys (specifically, the Alsek, Chilkat, Taiya, Taku, Stikine, and Unuk rivers, and Thomas Bay) and, more recently, on islands in the Alexander Archipelago in close proximity to the mainland (Etolin, Kupreanof, Mitkof, and Wrangell islands; Alaska Department of Fish and Game 1973). In addition, various residents of the region have reported occasional sightings of Moose on a number of other islands in the Alexander Archipelago (north Chichagof, Lemesurier and Pleasant Islands in Icy Strait, Kuiu, Prince of Wales, Revillagigedo, and Woewodski islands).

Two subspecies may occur in the area: *Alces a. andersoni* on Stikine and Unuk rivers may intergrade with *A. a. gigas* from the Taku River (Klein 1965; Hall 1981).

Moose were transplanted to Berners Bay from the Susitna and Matanuska valleys in 1958 and 1960, and to the Chickamin River from Anchorage-area stock in 1963 and 1964. Burris and McKnight (1973) note that a few Moose had occasionally been observed on the Chickamin River prior to their introduction. Moose are occasionally seen in the Salmon River and Hyder area (R. Thomas, personal communication 1990).

### *Rangifer tarandus* (Linnaeus, 1758), Caribou

The probable rare occurrence of Caribou in northern Southeast Alaska is based upon three sources. One is Olaus Murie (1935: 69, 71) who wrote, "According to Indian information, Caribou reach the summit of the Coast Range near Skagway but do not occur on the south slope...Certain Indians declared that Caribou used to be at Haines, Alaska, and they thought that the animals were working back that way." A recent report (about 1990) of a Caribou seen by local residents near the Kelsall River Valley, north of Haines (S. Brewington, personal communication 1994) supports this claim. Finally, Home (1973*) provides two separate reports of Caribou from the area north and inland of Goose Cove, upper Glacier Bay, one in the late 1950s and another in 1967. Recently, a partial metacarpal of a Caribou has been recovered from a cave on Prince of Wales Island (J. Baichtal, personal communication 1995).

*Oreamnos americanus* (de Blainville, 1816), Mountain Goat

Mountain Goats are found in suitable habitat along the entire mainland coast of Southeast Alaska. The only island record of natural occurrence is that of a single animal seen on Wrangell Island for several years (Klein 1965).

This species was successfully introduced on Baranof Island in 1923 (Burris and McKnight 1973). Transplant attempts to Chichagof Island in 1953 and again in 1955 were considered failures (Burris and McKnight 1973; L. Johnson, personal communication 1994). The most recent transplant of Mountain Goats in the Alexander Archipelago was on Revillagigedo Island in 1983 (Smith and Nichols 1984) and this population is extant (J. Gustafson, personal communication 1994).

*Ovis dalli* Nelson, 1884, Dall's Sheep

Dall's Sheep are found adjacent to Southeast Alaska in British Columbia, on the drier western slopes of the Saint Elias Mountains and the Coast Mountains north of Haines and Skagway (Klein 1965; Nichols 1978).

The occurrence of Dall's Sheep in Southeast Alaska is based on a female collected from the Kelsall River Valley, northwest of Haines, by ADF&G biologists (R. Flynn, personal communication 1994; specimen not located). A trapper family living on the Chilkat River occasionally observed sheep along the US/Canada border in the vicinity of Mount Raymond, not far from where ADF&G collected the female sheep (S. Brewington, personal communication 1994).

Three *O. dalli* skulls collected by Allen Hasselborg for the MVZ are said to be from Southeast Alaska, but no other information is provided. C. P. Streator, in his July-September 1895 summary notes to the Biological Survey, stated this about Dall's Sheep in Southeast Alaska: "A[n] interior [BC] mammal but found at the head of a number of the large inlets". There was no further elaboration.

## Faunal Composition

Excluding human beings and marine mammals, 54 species of mammals, representing 38 genera, 16 families, and 6 orders, are known to occur or have recently occurred in Southeast Alaska (Table 2). They constitute 86 subspecies and monotypic species. Of these, 27 (excluding *Ursus arctos*) are essentially endemic to Southeast Alaska. Rodents, with 20 species, constitute the most speciose order, followed by carnivores with 14 species.

Forty-eight species are native and extant. Four extant species are not native to the region: *Oryctolagus cuniculus*, *Rattus norvegicus*, *Mus musculus*, and *Cervus elaphus*. *Procyon lotor* and *Alopex lagopus*, also not native, are now believed extirpated.

New species confirmed present in the region since Hall (1981) are *Ochotona collaris*, *Martes pennanti*, and *Puma concolor*. New species, as yet unconfirmed by voucher specimen, are *Mustela nivalis*, *Rangifer tarandus*, and *Ovis dalli*.

## Distribution Patterns

*Biogeographic subregions*

While many gaps in our knowledge of mammals have been filled in recent years, our current understanding of mammal distribution patterns remains similar to that first outlined by Swarth (1911, 1936). His delineation of biogeographic subregions of Southeast Alaska are in general agreement with the new information, although we further refine his analysis below. Based on the presence of endemic taxa and unique combinations of native species, Southeast Alaska can be reduced to five subregions (Figure 2, Table 1). These subregions agree with Swarth (1911, 1936), except that he combined Admiralty, Baranof, and Chichagof islands into a single subregion. The subregions should be viewed as an hypothesis that can be tested by examining relationships among populations of species that are widespread throughout the region. Molecular systematics, in particular, holds great promise for characterizing relationships among island and mainland populations in Southeast Alaska (e.g., Gilbert et al. 1990).

*1. Mainland.* The mainland coast of Southeast Alaska has several connections to interior Canada through trans-mountain corridors along the major river systems. It forms a definable and species-rich subregion. Several islands (e.g., Douglas, Farm) are included in this subregion due to their proximity to the mainland coast. Mammals indicative of Mainland include *Sorex palustris*, *Marmota caligata*, *Zapus princeps*, and *Oreamnos americanus*. A number of species such as *Ochotona collaris*, *Spermophilus parryii*, *Neotoma cinerea*, *Martes pennanti*, *Mustela nivalis*, *Canis latrans*, *Vulpes vulpes*, *Lynx canadensis*, *Rangifer tarandus*, and *Ovis dalli* have been documented only in this subregion. Elevations above 1000 m along the mainland remain some of the least explored areas of the region and the ranges of a number of species need to be clarified. Species like *Sorex hoyi*, *Tamias minimus*, *Lemmus trimucronatus*, *Microtus miurus*, and *Phenacomys intermedius* occur just to the east in British Columbia or Yukon. Specimens of *P. intermedius* were collected within 2 km of the Canada border near Hyder in 1995. Six mammals are endemic to this subregion (Table 1) and Hall (1984) considered *Ursus arctos dalli* endemic to the Yakutat area.

*2. Middle and Southern Inner Islands.* This subregion includes those islands in the Alexander Archipelago south of Frederick Sound that are relatively near the mainland. These islands share several taxa that are otherwise found only in the Mainland subregion including *Tamiasciurus hudsonicus*, *Gulo gulo*, and *Alces alces*. The latter species, along with *Clethrionomys gapperi*, *Synaptomys borealis*, and *Erethizon dorsatum*, illustrate a general pattern of

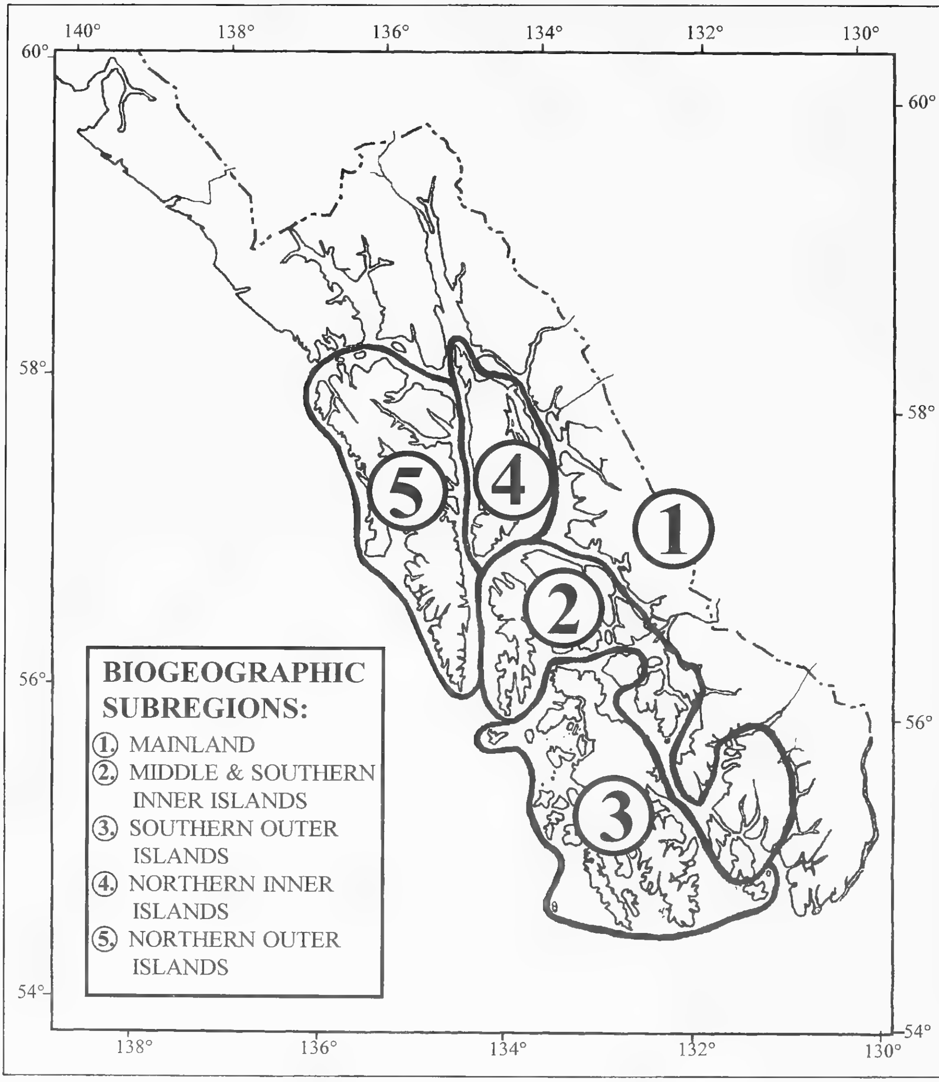


FIGURE 2. Five biogeographic subregions can be identified in Southeast Alaska based on the presence of unique combinations of taxa and endemics (Table 1).

westward postglacial colonization into the archipelago. *Clethrionomys gapperi solus* is considered endemic to this subregion (Hall 1981).

*3. Southern Outer Islands.* Prince of Wales and the numerous small islands to the west form a relatively distinct and insular subregion. Clarence Straits serves as a formidable barrier to faunal movement to the east except, perhaps, in the vicinity of Snow Passage and the Kashevarof Islands at the northeast end of Prince of Wales Island. Those islands may function as a dispersal corridor. Swarth (1911) also included Zarembo Island in this subregion. The absence of *Sorex cinereus* and *Martes americana* on Zarembo Island lends support to this hypothesis, although Zarembo Island shares some taxa with subregion 2. We tentatively include the outer islands of Coronation, Warren, Forrester, Duke, and Mary within this subregion.

Six taxa are considered endemic to this subregion: *Sorex monticolus malitiosus*, *Glaucomys sabrinus griseifrons*, *Peromyscus keeni oceanicus*, *Microtus coronarius*, *Mustela erminea celenda*, and *M. e. seclusa*.

*4. Northern Inner Islands.* Admiralty Island is separated from Mainland by Stephens Passage and from the Northern Outer Islands by Chatham Strait. Admiralty Island shares *Ursus arctos* (considered an endemic subspecies, *U. a. sitkensis*, by Hall 1984)

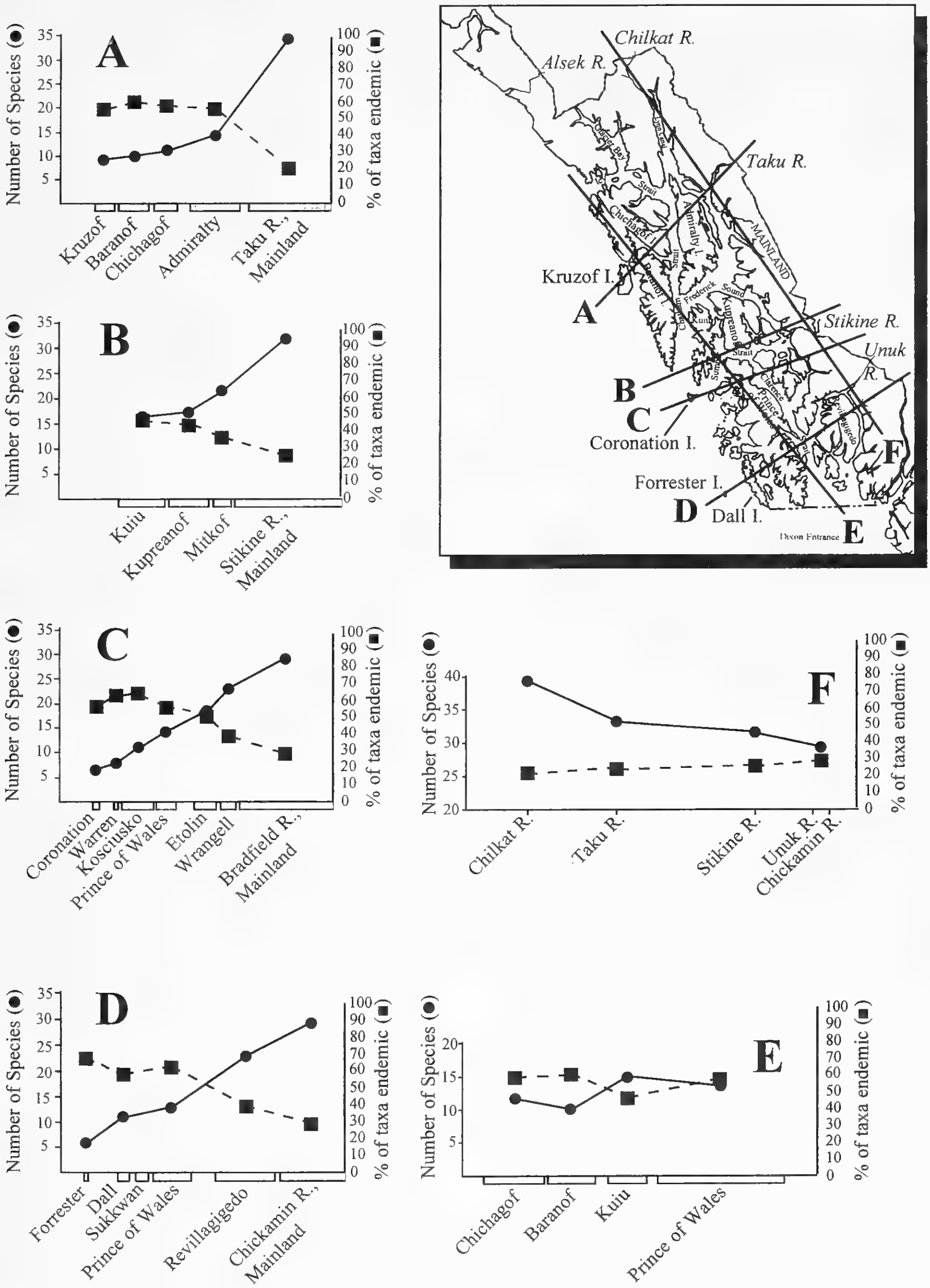


Figure 3. Patterns of species richness and endemism of native land mammals along six transects in Southeast Alaska.

and an absence of *Canis lupus* with the Northern Outer Islands. Many features of its mammal fauna set the two subregions distinctly apart, however, including the presence on Admiralty Island of *Sorex monticolus* (and absence of *S. cinereus*), *Microtus pennsylvanicus*, *Ondatra zibethicus*, and *Martes americana*. Furthermore, the apparent morphological distinctiveness of *Microtus pennsylvanicus admiraltiae* (Heller 1909), *Castor canadensis phaeus* (Heller 1909), *Mustela erminea salva* (Hall 1951) and, pos-

sibly, *Martes americana* ("very different looking", L. Johnson and R. Flynn, personal communications 1994) suggest a relatively high degree of endemism. Thus, we consider Admiralty Island, including several of the smaller adjacent islands, a distinct biogeographic subregion of Southeast Alaska.

*5. Northern Outer Islands.* Islands in this subregion, including Baranof, Chichagof, Yakobi and surrounding islands, are relatively isolated from the mainland to the north by Cross Sound and Icy Strait (although Brown Bear and Moose have been known to cross) and from Admiralty Island to the east by Chatham Strait.

*Microtus oeconomus sitkensis* (Merriam 1897) and *Mustela erminea initis* (Hall 1944, 1951) are endemic to this subregion. *Castor canadensis phaeus* (Hall 1981) and *Ursus arctos sitkensis* (Hall 1984) may also be endemic.

*Species Richness and Endemics*

Patterns of species richness across the complex landscape of Southeast Alaska were first noted by Swarth (1936). He suggested a general pattern of increasing species richness across the archipelago moving west to east from the Gulf of Alaska toward the mainland. This pattern is consistent along four west-east transects (Figure 3A-D), and by comparing the number of species across the subregions (Table 1). Decreasing species richness with increasing distance from the mainland source populations is a common attribute of archipelagos (Simberloff and Wilson 1969).

Contrary to documented latitudinal gradients for mammals (Huston 1994), there is a south-to-north increase in species richness along the mainland. The upper Lynn Canal area supports the highest number of mammal species for Southeast Alaska (Figure 3F). The south-to-north increase in richness along Southeast Alaska's mainland reflects the history of glaciation in this region. In the Haines and Skagway area, species typical of the coastal fauna (and flora) meet species of both interior British Columbia (species of southern origin such as *Lepus americanus*, *Canis latrans*, and *Puma concolor*) and interior Alaska and Yukon (Beringian origin such as *Ochotona collaris*, *Clethrionomys rutilus*, *Microtus oeconomus*, *Mustela nivalis*, and *Ovis dalli*; Youngman 1975). No latitudinal increase in species richness is evident along the outer islands of the Alexander Archipelago (Figure 3E).

The naturally fragmented and insular nature of Southeast Alaska suggests a high potential for evolutionary divergence and endemism (Anderson 1994) and at least 27 mammalian taxa have been described as occurring only in this region (Hall 1981). Klein (1965) first noted that the proportion of endemic taxa (to total number of taxa present) across the landscape of Southeast Alaska decreases as one moves eastward from the more isolated outer islands of the Alexander Archipelago toward the mainland (Figure 3A-D). The pattern is most pronounced across the southern end of the archipelago (Figure 4D). This is not surprising as Prince of Wales Island and the numerous smaller islands that comprise the Southern Outer Islands subregion (Figure 2) harbor the largest number of endemics on the archipelago (n = 6; Table 1). High endemism in that subregion is followed in the archipelago by the Northern Inner Islands (n = 3), the Northern Outer Islands (n = 2), and the Middle and Southern Subregion (n = 1). Nonetheless, the highest absolute number of endemics is found in the Mainland subregion, reflecting its extensive latitudinal span and relative isolation from the remainder of North America. The relative isolation of the entire region may be the primary factor responsible for elevated level of endemism (Anderson 1994), however, the possibility that some endemics are much older than previously suggested (Swarth 1936) is under investigation (Stone et al. 1996*).

Whether some members of the current fauna immigrated to these subregions since the last glaciation (ca. 10-12 000 years ago) and subsequently differentiated (i.e, neoendemics, Myers and Giller 1988) or whether some of the endemics are remnants of a relictual fauna that was more widely distributed prior to the last glaciation (paleoendemics) is basic to our interpretation of the evolution of this fauna.

*Origins*

An overview of the terrestrial mammals of Southeast Alaska is incomplete without considering the fauna's origins. First addressed by Swarth (1936), and later expanded and refined (Klein 1965), the history of mammal colonization and evolution in Southeast Alaska has been dynamic and complex. Both Swarth and Klein worked under the assumption that the last glacial maxima (the Fraser or late-Wisconsin glacial) essentially covered all of Southeast Alaska, and that the current distributions of mammals were the result of factors affecting post-glacial colonization from refugia outside the region. The large number of endemic forms now present on a number of outer islands of the archipelago was explained by them within the Holocene time frame (i.e., as neoendemics).

While Swarth (1936: 61) concluded that "whatever is peculiar to the Sitkan fauna and flora inevitably has developed subsequent to the Pleistocene time", and that active colonization is discernible at the present time, he remained troubled by the peculiar distributions of two insular mammals, *Peromyscus sitkensis* and *Microtus coronarius*. To him, these well defined forms afforded corroborative evidence of a relict fauna surviving the last glaciation. Cowan (1935) also concluded that the *P. sitkensis* group, as well as some of the island endemic forms of *Sorex monticolus*, were outer island survivors of the late-

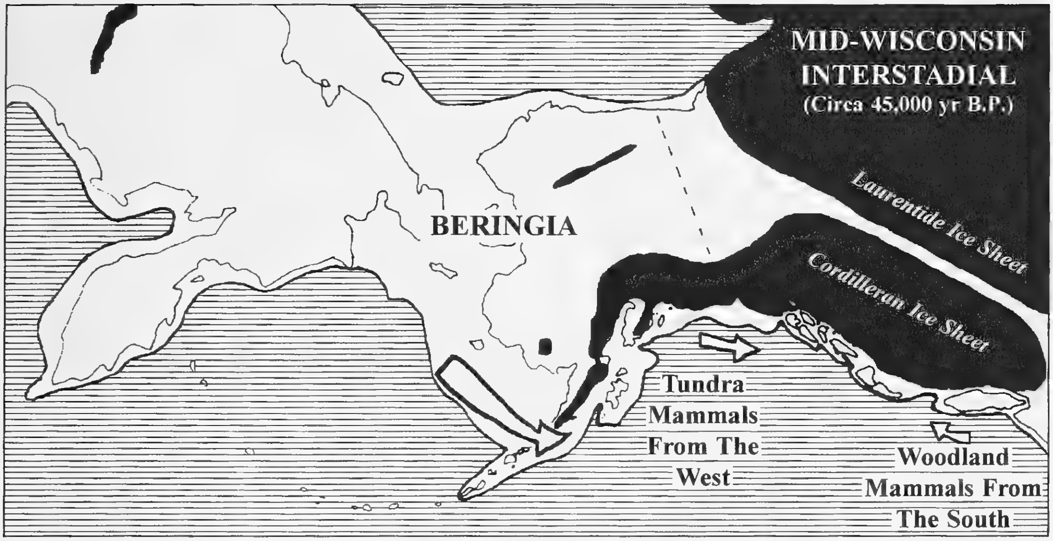


FIGURE 4. Approximate extent of glaciers during the height of the Mid-Wisconsin Interstadial (60 000 - 30 000 yr B. P.) including the potential patterns of colonization of mammals along the ice-free corridor of the North Gulf Coast. Tundra-adapted mammals from southern Beringia may have included: *Sorex jacksoni*, *Lepus othus*, *Marmota camtschatica*, *M. broweri*, *Spermophilus parryii*, *Clethrionomys rutilus*, *Microtus oeconomus*, *M. miurus*, *Lemmus* sp., *Dicrostonyx* sp., *Canis lupus*, *Vulpes vulpes*, *Alopex lagopus*, *Ursus arctos*, *U. maritimus*, *Mustela erminea*, *Gulo gulo*, and *Rangifer tarandus*. Possible colonizers from the south include *Sorex monticolus*, *Peromyscus* sp., *Microtus longicaudus*, *Ursus americanus*, and *Sorex palustris*.

Wisconsin glaciation. That these taxa possibly represent paleoendemics was again raised (Klein 1965). He expanded the geographic scope of the discussion to include hypothesized refugia outside Southeast Alaska to the south on the Queen Charlotte Islands and northwest along the coast to Prince William Sound, Kenai Peninsula, and Kodiak Island (see also Heusser 1960, 1989; Molnia 1986; Mann 1986; O'Reilly et al. 1993). Klein (1965) also introduced the possibility that the continental shelf, which would have been exposed due to a lowered sea level during the last glacial advance, may have provided refugia. Not considered were the origins of relict populations prior to the last glacial.

Along with an increasing appreciation of the dynamic nature of the distributions of mammals throughout the region, two initiatives have considerable promise for clarifying the history of the region. One is the ability to recover phylogenetic relationships from molecular genetic data, providing a view of patterns of colonization and relationships among populations. Another is the recent discovery of hundreds of caves in the extensive karst of Prince of Wales and other islands. Some of these caves are yielding a wealth of mammal bones, some of which have dated as far back as the Mid-Wisconsin (over 30 000 y B.P.). These fossil discoveries and ongoing molecular phylogenetic studies of several taxa (e.g., Stone et al. 1996*) are beginning to challenge earlier assumptions and expand our vision of the origin of this fauna both spatially and temporally.

Heaton (1995) used radiocarbon dates to document both *Ursus arctos* and *U. americanus* on Prince of Wales Island in the early Holocene and in the previous mid-Wisconsin interstadial (60 000 to 30 000 y B.P.; Mann 1986; Elias 1995). *Ursus arctos* no longer occurs on Prince of Wales Island and *U. americanus* was previously thought to have arrived there after the last glacial. Also discovered were teeth of *Marmota* sp. (> 44 500 y B.P.). Other mammal fossils, as yet undated, included *Peromyscus* sp., *Vulpes vulpes*, *Mustela erminea*, and *Rangifer tarandus* (Heaton and Grady 1992, 1993; Heaton 1995; J. Baichtal, personal communication).

This deep history of occurrence provides an alternative to the clean-slate hypothesis of postglacial colonization (Swarth 1936; Clague 1989). A scenario that includes the presence of refugia within the region throughout the late-Wisconsin glacial maxima suggests that some mammals may be paleoendemics, with an evolutionary history in the region that dates from at least the last interstadial (Rogers et al. 1991). The possible existence of Ice Age refugia in Southeast Alaska, such as has been hypothesized for the Queen Charlotte Islands (Heusser 1989; O'Reilly et al. 1993), may explain why some members of the Southeast Alaska mammal fauna are distinctive. Recent DNA studies of insular populations of *Ursus*

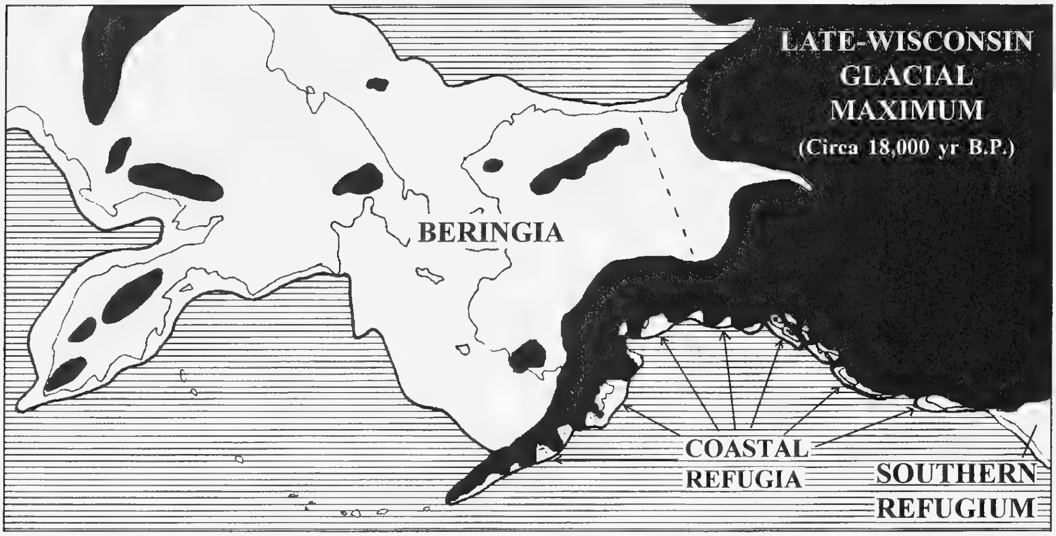


FIGURE 5. Approximate extent of glaciers during the Late-Wisconsin (Fraser) about 18 000 yr B. P. Arrows indicate possible ice free refugia found along the North Gulf Coast during this period (Heusser 1960; Hopkins 1967; Heusser 1989; and references therein).

*arctos* in Southeast Alaska are consistent with this hypothesis (Talbot and Shields 1996).

The discovery of pre-Fraser marmot teeth found on Prince of Wales Island is of particular interest (Heaton 1995). Today, *Marmota caligata* occurs only on the mainland, and is thought to be of southern origin (Youngman 1975). Heaton (1995) noted that the marmot molar found on Prince of Wales Island was smaller than *Marmota caligata*, and similar in size to *Marmota flaviventris*, found farther south and east. Alternatively, this marmot may be more closely related to *M. broweri* or *M. camtschatica*, small-bodied species of marmots now occurring on the west and east sides, respectively, of what was once Beringia (see Hoffmann et al. 1979). Or, it may be related to other smaller-bodied forms of marmots including *M. c. vigilis*, an endemic subspecies from Glacier Bay; or *M. c. sheldoni*, another smaller-sized endemic, last seen in 1908 on Montague Island, Prince William Sound (Howell 1915; Hoffmann et al. 1979). A northern origin for the Prince of Wales Island marmot, rather than southern as mentioned by Heaton (1995), is consistent with the affinities of most of the fossil mammals found recently. Since most of these fossils are of Holarctic, tundra-adapted species, we propose that, similar to hypotheses advanced for human migration into the New World (Fladmark 1979), a corridor existed along the coast from southern Beringia to the southern end of Cordilleran ice sheet (Figure 4) from the last interstadial to the early Holocene. Such a corridor implies a connection along the continental shelf which was exposed by a lowered sea level (Figure 4) and would have allowed Beringian species to track (sensu Eldridge 1995) tundra habitat eastward along the coast. Such a corridor may also have allowed southern refugial species adapted to woodland habitat to move northward.

The return of the late-Wisconsin glaciation effectively fragmented the mammal fauna into isolated refugia along the coast (Figure 5). This hypothesis predicts that some of the numerous endemics found along the Pacific Coast of Alaska (Figure 6) may be paleoendemics or remnants of much more widespread taxa, rather than neoendemics that arrived in their present locations since the last glacial maxima. The arrival of the Holocene warming (Figure 6) resulted in a rise of sea level and the eventual inundation of the Bering Land Bridge and the continental shelf along the Gulf Coast. While this was occurring, tundra habitats generally retreated to the northwest, while Pacific coastal forests advanced northward along the coast, arriving as far as Kodiak Island approximately 1000 y B.P. (Elias 1995).

Thus, the high concentration of endemics noted for Southeast Alaska and areas surrounding the Gulf of Alaska may be the result of deeper historical events than previously envisioned. Alternatively, these endemics may be relatively recent immigrants that have evolved rapidly due to island effects (Foster 1964; Adler and Levins 1994; Lance 1995). At this time, these hypotheses cannot be effectively tested because the evolutionary relationships of the endemics, or their taxonomic status for that matter, are poorly understood.

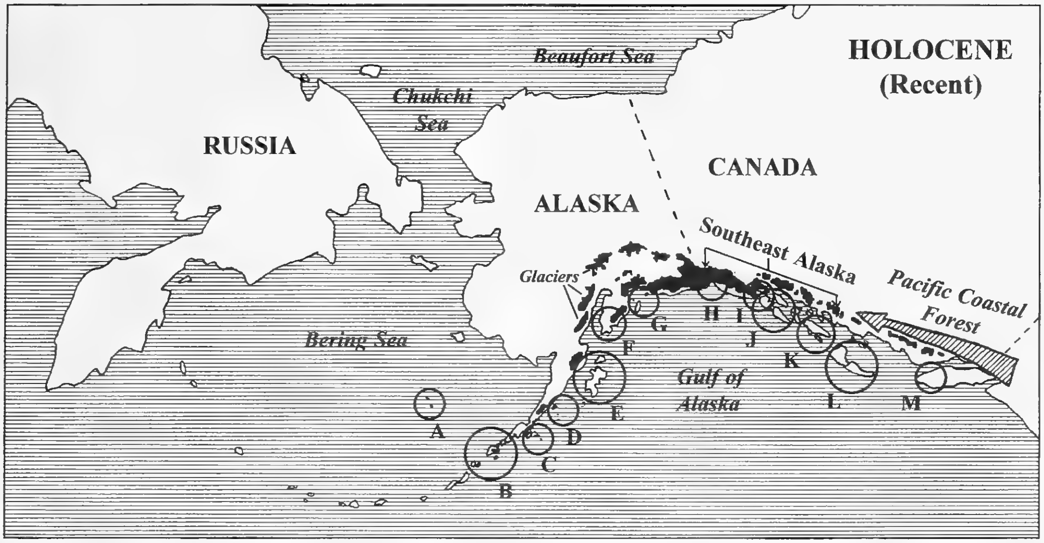


FIGURE 6. Localities (circled) with concentrations of potential relict faunas (paleoendemics) along the North Gulf Coast. Mammals that occur or have recently occurred at these localities include: *Sorex hydrodromus* (A), *S. cinereus* (B, F, G, H, I, J), *S. monticolus* (B, C, F-I, K, L, M), *S. palustris* (I, M), *Lepus othus* (B, C), *Marmota* sp. (F, G, I, K[fossil], M), *Spermophilus* sp. (B-F), *Peromyscus* sp. (J, K, L, M), *Clethrionomys rutilus* (G-I), *Microtus oeconomus* (B-E, F-J), *Vulpes vulpes* (B, C, E-G, K[fossil]), *Ursus americanus* (F, H, I, K[includes fossil], L, M), *U. arctos* (B, E-G, J, K[fossil], *Mustela erminea* (B, E-G, J, K[includes fossil], L, M), *Gulo gulo* (B, F, M), and *Rangifer tarandus* (B, C, E[bones in midden], F[extinct circa 1913], K[fossil], L[extinct circa 1910]). Arrow represents postglacial advance of Pacific coastal forest and associated fauna.

## Conclusions

Further excavation of fossil materials from the karst region of Southeast Alaska will continue to clarify our understanding of the composition and test hypotheses related to the origins of this fauna. In addition to paleontology, investigations of the molecular systematics of the extant and extinct mammals offers an opportunity to examine the temporal dynamics of a regional fauna that was shaped by late-Pleistocene events. Our ability to characterize the nature of endemicity with molecular data will be particularly valuable for establishing the temporal sequence of events, particularly with respect to separating paleoendemics from neoendemics.

Knowledge of distributions of organisms is fundamental to our understanding and conservation of biological diversity (e.g., Meffe and Carroll 1994). Well-documented scientific surveys are fundamental to basic theoretical research conducted in this coastal region as well as for applied management decisions related to the evaluation of impacts of perturbations on the biota (Miller 1993; Miller and Scudder 1994; Raven and Wilson 1992). Throughout Southeast Alaska we still lack the baseline data needed to identify and monitor areas of high species richness and heavy concentrations of endemic taxa (biodiversity "hot spots"; Noss and Cooperrider 1994).

Controversy surrounds past, present, and projected future human-induced change in this region (United States Department of Agriculture 1991, 1996) and a sustained effort to document the fauna and flora of this region is needed. The recent clear-cut harvest of timber on most of Long Island, an island with good potential for supporting endemics, is an extreme example of what has occurred in this region. Proposed logging on small islands, as well as existing stands of old-growth on the larger islands may significantly impact endemic taxa (e.g., *Glaucomys sabrinus griseifrons*).

In addition to habitat perturbation and change, endemic forms on the islands, in particular, may be negatively affected by species introductions. The drastic effects on insular faunas of the introduction of exotic species has been well documented throughout the world (e.g., Kaufman and Ochumba 1993). A number of the insular taxa noted in this report could be similarly impacted. Such introductions recently have been implicated in the declining seabird colonies of the Queen Charlotte Islands (Gaston 1994; Bertram and Nagorsen 1995). Bailey (1993) reports introductions of Arctic Fox (*Alopex lagopus*) on over 180 islands in Southeast Alaska. Few data are available for assessing the impact of introductions on insular populations of the Alexander Archipelago, however, numerous introductions of

Elk, Mountain Goat, Red Squirrel, Muskrat, Snowshoe Hare, Raccoon, and Marten are known and introductions continue today (Table 2).

The Tongass National Forest comprises nearly 80% of Southeast Alaska's landmass. Considerable public and scientific attention is now focused on the loss of biodiversity on federal lands. We conclude that this inventory of the mammal fauna is but the first step. The need for a comprehensive inventory of the region's biological diversity is urgent, given the rapid changes that are occurring on many islands with a high potential for endemism. Delay in action may have irreparable consequences that will greatly increase the duration, expense, and probability of failure of recovery efforts (Murphy et al. 1994).

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# Relative Abundance, Migration Strategy, and Habitat Use of Birds Breeding in Denali National Park, Alaska

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The breeding bird community in Denali National Park, Alaska, was studied over a three-year period (1993–1995). Birds were surveyed from nine off-road routes in spruce forests from 1993–1995 and from four on-road routes in 1994 and 1995. Thirty-nine species were detected during off-road routes, whereas 80 species were detected from on-road routes. The most abundant species were sparrows (White-crowned Sparrow [*Zonotrichia leucophrys*], American Tree Sparrow [*Spizella arborea*], and Savannah Sparrow [*Passerculus sandwichensis*]) and warblers (Wilson's Warbler [*Wilsonia pusilla*] and Orange-crowned Warbler [*Vermivora celata*]). The avian community in Denali National Park was similar to other areas in the region, although there were some distinctive differences. The majority of detected individuals (69%) presumably migrate to the tropics; residents accounted for only 9% of the individuals detected. Shrublands had the greatest relative abundance of any habitats surveyed, whereas species richness was greatest in tall shrub and spruce forest habitats. These findings generally concur with previous research in the region. Both habitats should be important components in any program that attempts to monitor avian populations in interior Alaska.

Key Words: birds, habitat use, abundance, migratory status, Denali National Park, Alaska.

Little has been published on avian communities breeding in forests and alpine tundra habitats of central, interior Alaska. West and DeWolfe (1974) calculated densities and energy consumption of birds nesting in forests near Fairbanks. Spindler and Kessel (1980) investigated avian community structure and habitat use in forests and shrub habitats near Northway. Farther to the south in Kluane National Park, Yukon Territory, Hoefs (1973) and Theberge (1976) described the abundance and habitat use of birds.

Although there is some qualitative information available on relative abundance of birds in the Denali area (Dixon 1938; Murie 1963; Kessel and Gibson 1978; Kertell 1988), few quantitative studies have been conducted on the birds in the Park, with the exception of investigations of raptors (e.g., Laing 1985). We investigated the avian community at Denali National Park from 1993 to 1995. We address the following questions: (1) what is the relative abundance of birds breeding in Denali National Park? (2) what are their migration strategies, that is, where do birds presumably migrate to after breeding in the Park? (3) which habitats have the greatest species richness and relative abundance, and which habitats do birds from different migratory strategies use? The answers to these questions are important because of avian monitoring programs being initiated in Alaska and the need to determine which habitats and species should be sampled in interior Alaska.

## Study Area and Methods

Denali National Park and Preserve (63°40′N, 149°30′W) is located in the central Alaska Range, approximately 210 km southwest of Fairbanks, Alaska. The Park is 2.4 million ha in size. A 150-km long road bisects the eastern half and our study area includes lands within 1 km of this dirt road. The climate is characterized by cold, snowy winters and cool summers. Dominant trees are White Spruce (*Picea glauca*), Black Spruce (*P. mariana*), Quaking Aspen (*Populus tremuloides*), Balsam Poplar (*P. balsamifera*) and Paper Birch (*Betula papyrifera*). Low, medium, and tall shrub habitats are characterized by willows (*Salix* spp.), Dwarf Birch (*B. glandulosa*), Mountain Alder (*Alnus crispa*), blueberry (*Vaccinium uliginosum*), and Mountain Cranberry (*V. vitis-idaea*). Alpine tundra is dominated by sedges, grasses and forbs. Elevations in the road corridor varies from 490 m to 1220 m. Forest habitats are restricted to areas below 600-900 m elevation, alpine tundra occurs above 915 m elevation, and the intervening elevations are dominated by shrub habitats. The growing season is relatively short, with most areas in the road corridor free of snow by mid-late June in most years. Permanent snowfields remains on north-facing slopes at higher elevations.

We used off- and on-road point counts to determine the relative abundance of birds in Denali National Park (Ralph et al. 1994; Hanowski and Niemi 1995). We established nine survey routes in spruce-dominated forests (hereafter off-road routes). Forests were defined as habitats where trees (i.e., single stemmed-woody plants > 3 m height) constituted > 10% of the crown cover (Viereck et al. 1992). Off-road routes were placed only in forest

stands that measured > 100 ha, and were < 0.5 km from the Park road. Each off-road route consisted of 12 stations spaced 250 m apart. Surveys were conducted from 10 to 30 June at the same 108 stations in 1993, 1994, and 1995. All birds detected at an unlimited distance from stations were recorded for a 5-minute period (Ralph et al. 1994).

We also conducted Breeding Bird Survey (BBS)-type surveys (Ralph et al 1994; hereafter on-road routes) along the entire length of the Park's main road. Each on-road route was surveyed twice in 1994 and 1995 from 8 to 23 June. Three on-road routes (i.e., Park Highway to the Teklanika River; Teklanika River to Porcupine Forest; and Porcupine Forest to McKinley Bar) were 39.2 km long and had 50 stations. The fourth on-road route, McKinley Bar to Jeholis' Cabin, was only 31.4 km long with 36 stations. Each station was surveyed for 3 minutes and observers drove between stations. Both on-road and off-road routes were initiated at 0330 ADT (± 15 minutes).

We classified migration strategies for all birds detected during our fieldwork in Alaska based on the previously published classifications schemes of Kessel and Gibson (1978), Gauthreaux (1991), Dobkin (1994), and Rappole (1995). Migration strategies for birds breeding in Denali were categorized as follows; *resident*: majority of the population resides in Alaska the entire year, although some populations may be irruptive certain years; *Nearctic migrant*: majority of population winters south of Alaska and north of tropic of Cancer; *short-distance Neotropical migrant*: all or part of the population winters south of tropic of Cancer, but north of South America; *long-distance Neotropical migrant*: majority of the population winters in South America; *Paleotropical migrant*: majority of population winters in the tropics of Asia. Two species of redpoll, *Carduelis flammea* and *C. hornemanni*, were combined into one taxon, redpoll, because of difficulties in identifying the two species (Troy 1985).

We used the percentage of stations with detections (hereafter frequency of occurrence; Bart and Klosiewski 1989) and the mean number of individuals per station (hereafter abundance) as indices to the relative abundance of birds in the Park. Species richness was calculated as the mean number of species detected per station. To determine annual fluctuations in abundance, we used the formula: $((\text{year}_2 - \text{year}_1)/\text{year}_1) \times 100$. We calculated annual fluctuations for species only that had individuals present both years. Species were categorized as having experienced significant population fluctuations if they increased by over 100% or declined by over 50% between years.

We determined habitat use of birds in the Park by measuring vegetation at 100 stations on the two on-road routes (i.e., Park Highway to Porcupine Forest) in 1995. Near each station, we placed three 25-m diameter vegetation plots, with plots located 120° apart. Vegetation plots were selectively located 25 to 100 m from the point count station to insure plots did not include the road. Within each vegetation plot, we measured the distance to the four nearest trees and determined the canopy cover of broadleaf and needleleaf trees with a densiometer. We also measured ground cover and shrub height at five points spaced 1 m apart in each of the four cardinal directions, yielding 20 height measurements per plot. We then categorized each 25 m vegetation plot into the habitat classification scheme of Viereck et al. (1992), using some modifications of Kessel (1979). Six habitats used for analyses presented here include: (1) *low-medium shrubs*: trees accounted for < 10% of cover, dominated by open or closed canopy (> 25% cover) shrub stands of willow, alder, or Dwarf Birch (≤ 2.4 m high; (2) *tall shrub thicket*: trees accounted for < 10% of cover, dominated by open or closed stands of willow or alder > 2.4 m tall, (3) *mixed forest*: broadleaf and needleleaf trees over 3 m tall are present, both deciduous and spruce contribute 25-75% of total tree canopy cover, and total canopy cover is greater than 25%. These forests consist of mixed stands of deciduous species (aspen, Balsam Poplar, or birch) and spruce; (4) *spruce woodland*: trees over 3 m tall are present, over 75% of tree cover is spruce, and canopy closure ranges from 10-24%; (5) *spruce forest*: trees over 3 m are present, over 75% of the tree cover is spruce, and canopy closure is over 25%; (6) *tundra*: areas above the upper limit of tree growth that support dwarf shrubs (< 20 cm tall), forbs, and herbs. Each station was classified into one of six habitats based on the dominant habitat at the three vegetation. We compared avian abundances between habitats using a random effects analysis-of-variance (ANOVA) model and Tukey's multiple comparison test (SAS 1988). Statistical significance was set at $\alpha = 0.05$ for all comparisons.

## Results

*Relative abundance*

*On-road routes:* We detected 80 species from on-road routes, with 69 species in 1994 compared to 65 species in 1995 (Table 1). Most species were uncommon; mean abundance of only 17 of 80 species was > 0.10 individuals per station. In addition, species that were absent one year were generally rare; only 26% had > 0.01 individuals detected per station ($n = 27$). Warblers and sparrows were the most abundant species encountered from on-road routes; White-crowned Sparrow, American Tree Sparrow (*Spizella arborea*), and Wilson's Warbler all had detection rates of > 1.0 individual per station in both years (Table 1). Other relatively common species included Savannah Sparrow (*Passerculus sandwichensis*),

TABLE 1. The mean number of individuals detected per station (n = 186 stations per year) for on-road routes in Denali National Park. Migration strategies are given following scientific names: RE = resident, SD = short-distance Neotropical migrant, LD = long-distance Neotropical migrant, NM = Nearctic migrant, PM = Paleotropical migrant.

| Species | 1994 | 1995 |
|---|---|---|
| Common Loon (*Gavia immer*) NM | +[1] | |
| Greater White-fronted Goose (*Anser albifrons*) SD | | + |
| Green-winged Teal (*Anas crecca*) SD | 0.03 | 0.01 |
| Mallard (*A. platyrhynchos*) SD | | + |
| Northern Pintail (*A. acuta*) SD | 0.01 | 0.01 |
| American Wigeon (*A. americana*) SD | 0.01 | 0.02 |
| Ring-necked Duck (*Aythya collaris*) SD | 0.08 | |
| Greater Scaup (*A. marila*) NM | + | |
| Lesser Scaup (*A. affinis*) SD | 0.08 | |
| Oldsquaw (*Clangula hyemalis*) NM | + | |
| White-winged Scoter (*Melanitta fusca*) NM | | 0.03 |
| Black Scoter (*M. nigra*) NM | + | |
| Surf Scoter (*M. perspicillata*) NM | | + |
| Barrow's Goldeneye (*Bucephala islandica*) NM | 0.01 | + |
| Bufflehead (*B. albeola*) NM | 0.02 | 0.01 |
| American Golden-Plover (*Pluvialis dominica*) LD | + | 0.02 |
| Whimbrel (*Numenius phaeopus*) SD | 0.02 | |
| Lesser Yellowlegs (*Tringa flavipes*) SD | 0.022 | 0.024 |
| Spotted Sandpiper (*Actitis macularia*) SD | + | + |
| Wandering Tattler (*Heteroscelus incanus*) SD | | + |
| Red-necked Phalarope (*Phalaropus lobatus*) LD | | + |
| Common Snipe (*Gallinago gallinago*) SD | 0.06 | 0.03 |
| Least Sandpiper (*Calidris minutilla*) SD | + | + |
| Upland Sandpiper (*Bartramia longicauda*) LD | + | + |
| Long-tailed Jaeger (*Stercorarius longicaudus*) LD | 0.03 | + |
| Bonaparte's Gull (*Larus philadelphia*) SD | 0.01 | + |
| Mew Gull (*L. canus*) NM | 0.23 | 0.10 |
| Herring Gull (*L. argentatus*) SD | 0.01 | |
| Arctic Tern (*Sterna paradisaea*) LD | + | |
| Golden Eagle (*Aquila chrysaetos*) SD | 0.02 | 0.02 |
| Northern Harrier (*Circus cyaneus*) SD | + | |
| Northern Goshawk (*Accipiter gentilis*) SD | + | |
| American Kestrel (*Falco sparverius*) SD | + | |
| Merlin (*Falco columbarius*) LD | 0.03 | + |
| Gyrfalcon (*Falco rusticolus*) NM | 0.01 | |
| Rock Ptarmigan (*Lagopus mutus*) RE | 0.02 | + |
| Willow Ptarmigan (*Lagopus lagopus*) RE | 0.03 | 0.04 |
| Short-eared Owl (*Asio flammeus*) SD | + | |
| Great Horned Owl (*Bubo virginianus*) RE | | + |
| Three-toed Woodpecker (*Picoides tridactylus*) RE | + | + |
| Northern Flicker (*Colaptes auratus*) NM | + | + |
| Olive-sided Flycatcher (*Contopus borealis*) LD | + | + |
| Say's Phoebe (*Sayornis saya*) SD | 0.02 | + |
| Alder Flycatcher (*Empidonax alnorum*) LD | 0.23 | 0.11 |
| Hammond's Flycatcher (*Empidonax hammondii*) SD | + | + |
| Horned Lark (*Eremophila alpestris*) SD | + | 0.01 |
| Violet-green Swallow (*Tachycineta thalassina*) SD | | + |
| Cliff Swallow (*Hirundo pyrrhonota*) LD | 0.10 | 0.30 |
| Gray Jay (*Perisoreus canadensis*) RE | 0.11 | 0.06 |
| Black-billed Magpie (*Pica pica*) RE | 0.03 | 0.08 |
| Common Raven (*Corvus corax*) RE | 0.02 | + |
| Black-capped Chickadee (*Parus atricapillus*) RE | + | + |
| Boreal Chickadee (*P. hudsonicus*) RE | 0.05 | 0.01 |
| Arctic Warbler (*Phylloscopus borealis*) PM | 0.36 | 0.25 |
| Ruby-crowned Kinglet (*Regulus calendula*) SD | 0.05 | 0.02 |
| Gray-cheeked Thrush (*C. minimus*) LD | 0.12 | 0.10 |
| Swainson's Thrush (*C. ustulatus*) LD | 0.22 | 0.15 |

*(Continued)*

TABLE 1. *Continued.*

| Species | 1994 | 1995 |
|---|---|---|
| Hermit Thrush (*C. guttatus*) SD | 0.04 | 0.02 |
| American Robin (*Turdus migratorius*) SD | 0.34 | 0.28 |
| Varied Thrush (*Ixoreus naevius*) NM | 0.12 | 0.14 |
| Northern Wheatear (*Oenanthe oenanthe*) PM | + | |
| Northern Shrike (*Lanius excubitor*) NM | + | + |
| American Pipit (*Anthus rubescens*) SD | + | + |
| Orange-crowned Warbler (*Vermivora celata*) SD | 0.76 | 0.88 |
| Yellow Warbler (*Dendroica petechia*) LD | | 0.01 |
| Yellow-rumped Warbler (*D. coronata*) SD | 0.20 | 0.22 |
| Blackpoll Warbler (*D. striata*) LD | | + |
| Northern Waterthrush (*Seiurus noveboracensis*) LD | | + |
| Wilson's Warbler (*Wilsonia pusilla*) LD | 1.19 | 1.16 |
| American Tree Sparrow (*Spizella arborea*) NM | 2.05 | 1.69 |
| Savannah Sparrow (*Passerculus sandwichensis*) SD | 0.92 | 0.70 |
| Fox Sparrow (*Passerella iliaca*) NM | 0.49 | 0.54 |
| Lincoln's Sparrow (*Melospiza lincolnii*) SD | + | + |
| Golden-crowned Sparrow (*Zonotrichia atricapilla*) NM | 0.07 | 0.09 |
| White-crowned Sparrow (*Zonotrichia leucophrys*) SD | 3.03 | 2.33 |
| Dark-eyed Junco (*Junco hyemalis*) NM | 0.32 | 0.28 |
| Lapland Longspur (*Calcarius lapponicus*) NM | 0.02 | 0.01 |
| Pine Siskin (*Carduelis pinus*) NM | + | |
| redpoll (*Carduelis* spp.) RE | 0.47 | 0.72 |
| White-winged Crossbill (*Loxia leucoptera*) RE | 0.07 | 0.06 |

[1]< 0.01 individuals per station.

Orange-crowned Warbler (*Vermivora celata*), redpoll, and Fox Sparrow (*Passerella iliaca*).

Fifteen of 80 species exhibited significant population fluctuations between 1994 and 1995 (Table 1). Species with particularly large annual fluctuations (i.e., an increase over 200% or a decline greater than 66.7%) were uncommon and included: the Bonaparte's Gull (*Larus philadelphia*), Merlin (*Falco columbarius*), Rock Ptarmigan (*Lagopus mutus*), Say's Phoebe (*Sayornis saya*), Cliff Swallow (*Hirundo pyrrhonota*), and Boreal Chickadee (*Parus hudsonicus*).

Our surveys were primarily designed to monitor passerines, but other taxa were also detected. Most species of waterfowl were relatively uncommon and tended to be restricted to kettle ponds on the west side of the Park. Diurnal raptors were also uncommon, although Golden Eagles (*Aquila chrysaetos*) were regularly observed both years, as were Merlins in 1994. Willow (*Lagopus lagopus*) and Rock Ptarmigan (*L. mutus*) were relatively scarce during on-road routes because surveys were conducted too late to detect displaying males (P. Paton, unpublished data). Typical of interior Alaska (Kessel and Gibson 1978), the density of nesting shorebirds (Charadriiformes) was extremely low, with the exception of the Lesser Yellowlegs (*Tringa flavipes*) and Common Snipe (*Gallinago gallinago*). The most common corvid in the Park was the Gray Jay (*Perisoreus canadensis*), where they were found primarily in spruce forests.

Many bird watchers visit Denali National Park to see specific species, most of which were uncommon in the Park during our surveys and included the following: seven pairs of Long-tailed Jaegers (*Stercorarius longicaudus*) nested near the road in 1994 compared to five pairs in 1995. Only three to four pairs of American Golden-Plovers (*Pluvialis dominica*) were found at higher elevations, where they apparently nested near breeding jaegars. Gyrfalcon (*Falco rusticolus*) nested at two eyries visible from the road in 1994. One eyrie was active in 1995 near Eielson Visitor Center, although no birds were seen during systematic surveys. The Northern Hawk Owl (*Surnia ulula*) was not found during our fieldwork, nor were there any reports of this elusive species occurring in the Park in 1993 to 1995. The Northern Wheatear (*Oenanthe oenanthe*) was only detected at one station on Thorofare Pass in 1994 and was seen at the same location in 1995 after surveys were completed. The Northern Shrike (*Lanius excubitor*) was detected nesting in the Porcupine Forest both years during fieldwork and Lapland Longspur (*Calcarius lapponicus*) nested in three sites in the tundra zone on Thorofare Pass, Stony Hill, and Highway Pass. Arctic Warblers (*Phylloscopus borealis*) were abundant in higher-elevation tall willow (*Salix* spp). thickets throughout the Park.

*Off-road routes:* Thirty-nine species were detected in 1993 to 1995 from off-road routes (Table 2). There was little annual variation in species richness

TABLE 2. The frequency of occurrence (% stations with detections) and relative abundance (mean number of individuals per station; n =108 per year) for off-road routes in spruce forests in Denali National Park.

| | Frequency of occurrence | | | Abundance | | |
|---|---|---|---|---|---|---|
| Species | 1993 | 1994 | 1995 | 1993 | 1994 | 1995 |
| Mallard | | 0.9 | | | +[1] | |
| Greater Yellowlegs | 0.9 | | | + | | |
| Lesser Yellowlegs | | 2.8 | 5.6 | | 0.06 | 0.08 |
| Spotted Sandpiper | 3.7 | | | 0.05 | | |
| Upland Sandpiper | | | 0.9 | | | + |
| Common Snipe | | | 0.9 | | | + |
| Mew Gull | 8.3 | 6.5 | 4.6 | 0.13 | 0.11 | 0.06 |
| Spruce Grouse (*Dendragapus canadensis*) | | | 1.9 | | | 0.02 |
| Three-toed Woodpecker | 1.9 | | 3.7 | 0.03 | | 0.04 |
| Northern Flicker | 0.9 | | | + | | |
| Olive-sided Flycatcher | 10.2 | 4.6 | 13.9 | 0.12 | 0.05 | 0.15 |
| Western Wood-Pewee (*Contopus sordidulus*) | 0.9 | | | + | | |
| Alder Flycatcher | | 0.9 | | | + | |
| Hammond's Flycatcher | | | 0.9 | | | + |
| Gray Jay | 35.2 | 24.1 | 16.7 | 0.52 | 0.42 | 0.20 |
| Black-billed Magpie | | 0.9 | | | + | |
| Common Raven | 2.8 | | | 0.05 | | |
| Boreal Chickadee | 9.3 | 15.7 | 7.4 | 0.17 | 0.24 | 0.11 |
| Ruby-crowned Kinglet | 10.2 | 13.9 | 11.1 | 0.15 | 0.19 | 0.11 |
| Gray-cheeked Thrush | 6.5 | 2.8 | 10.2 | 0.07 | 0.04 | 0.14 |
| Swainson's Thrush | 54.6 | 71.3 | 47.2 | 0.89 | 1.51 | 0.85 |
| Varied Thrush | 40.7 | 57.4 | 46.3 | 0.58 | 1.06 | 0.75 |
| American Robin | 50.9 | 43.5 | 43.5 | 0.67 | 0.62 | 0.57 |
| Bohemian Waxwing (*Bombycilla garrulus*) | 4.6 | 2.8 | | 0.07 | 0.13 | |
| Orange-crowned Warbler | 28.7 | 16.7 | 29.6 | 0.38 | 0.20 | 0.43 |
| Yellow-rumped Warbler | 37.0 | 65.7 | 56.5 | 0.58 | 1.08 | 0.82 |
| Blackpoll Warbler | 0.9 | | | + | | |
| Northern Waterthrush | 0.9 | | | 0.02 | | |
| Wilson's Warbler | 29.6 | 36.1 | 38.9 | 0.42 | 0.50 | 0.52 |
| American Tree Sparrow | 29.6 | 29.6 | 31.5 | 0.53 | 0.74 | 0.56 |
| Savannah Sparrow | 5.6 | 13.0 | 9.3 | 0.19 | 0.23 | 0.12 |
| Fox Sparrow | 4.6 | 9.3 | 2.8 | 0.03 | 0.13 | 0.03 |
| Lincoln's Sparrow | 2.8 | 4.6 | | 0.03 | 0.07 | |
| White-crowned Sparrow | 61.1 | 72.2 | 76.9 | 1.42 | 2.03 | 1.94 |
| Dark-eyed Junco | 73.1 | 80.6 | 73.1 | 1.57 | 1.86 | 1.45 |
| redpoll | 65.7 | 25.9 | 36.1 | 1.59 | 0.45 | 0.45 |
| Pine Siskin | | | 0.9 | | | + |
| White-winged Crossbill | 11.1 | 39.8 | 1.9 | 0.59 | 4.83 | 0.07 |

[1]+<0.01 individuals per station.

on off-road routes: 30 species were detected in 1993, 26 species in 1994, and 27 species in 1995. Twenty species were found all three years, 4 species were missed only in one year, and 15 species were detected only in one year. The Dark-eyed Junco (*Junco hyemalis*), White-crowned Sparrow (*Zonotrichia leucophrys*), and Swainson's Thrush (*Catharus ustulatus*) were consistently the most common species detected from off-road routes, both in terms of frequency of occurrence and abundance (Table 2). Two resident species were widespread in only one year; redpolls occurred at over 65% of all stations in 1993, and flocks of 50 White-winged Crossbills (*Loxia leucoptera*) were encountered in 1994. Three species of thrush (Turdinae) were common throughout Denali's spruce forests [the Swainson's Thrush, Varied Thrush (*Ixoreus naevius*), and American Robin (*Turdus migratorius*)], whereas the Gray-cheeked Thrush (*Catharus minimus*) were common only on the west side of the Park. The most abundant species of warbler (Parulinae) from off-road routes was the Yellow-rumped (Myrtle) Warbler (*Dendroica coronata coronata*).

Twenty-six percent of the species found on off-road routes exhibited large fluctuations in abundance between years. The White-winged Crossbill experienced the greatest annual fluctuation, with a 98.5% decline in individuals detected from 522 in 1994 to 8 in 1995 (Table 1). Other species with large annual fluctuations (i.e., > 200% increase or > 66.7% decline) included the Olive-sided Flycatcher (*Contopus borealis*), Gray-cheeked Thrush, Hermit

TABLE 3. The migration strategies for birds detected in six habitat types during on-road routes in Denali National Park.

| Habitat type | Migration strategy | | | | |
|---|---|---|---|---|---|
| | Resident | Nearctic | Short-distance Neotropical | Long-distance Neotropical | Paleotropical |
| | | | **Relative abundance** (% of individuals detected) | | |
| Spruce forest | 9.6 | 9.9 | 63.1 | 17.1 | 0.3 |
| Spruce woodland | 12.7 | 20.7 | 47.2 | 18.5 | 0.9 |
| Mixed forest | 5.5 | 9.8 | 58.7 | 25.9 | 0 |
| Low-medium shrub | 6.8 | 29.2 | 46.2 | 16.6 | 1.1 |
| Tall shrub | 9.0 | 20.5 | 36.3 | 25.8 | 8.5 |
| Tundra | 12.0 | 18.4 | 33.1 | 23.0 | 13.4 |
| | | | **Species richness** (% of species detected) | | |
| Spruce forest | 12.1 | 12.1 | 53.6 | 21.7 | 0.5 |
| Spruce woodland | 14.8 | 17.3 | 44.1 | 22.5 | 1.3 |
| Mixed forest | 5.6 | 12.2 | 57.2 | 25.0 | 0 |
| Low-medium shrub | 12.2 | 19.2 | 42.7 | 24.3 | 1.6 |
| Tall shrub | 11.7 | 16.0 | 35.1 | 28.6 | 8.6 |
| Tundra | 13.3 | 17.7 | 32.6 | 23.6 | 12.7 |

Thrush (*Catharus guttatus*), Fox Sparrow (*Passerella iliaca*), and redpolls.

*Migration strategies*

The majority of species (62.5%) detected during on-road surveys along the Denali National Park road corridor migrate to the tropics; 34 species were short-distance Neotropical migrants (SDM), 14 species were long-distance Neotropical migrants (LDM), 19 species were Nearctic migrants (NM), 11 taxa were residents (RES), and 2 species were Paleotropical migrants (PM) (Table 1). When water-birds (Gaviiformes, Anseriformes, and Charadriiformes) were excluded from this analysis, 58.8% of total avifauna were tropical migrants; 19 SDM, 9 LDM, 11 RES, 10 NM, and 2 PM. Species richness averaged 5.7 species per station for on-routes in 1994 and 1995, and the majority were Neotropical migrants; 42.5% SDM, 24.3% LDM, 16.9% RES, 12.2% NM, and 4.1% PM (Table 3). Tropical migrants also accounted for the majority of individuals (71.7%, $n = 8594$ individuals) detected from on-road stations in 1994 and 1995; 45.1% SDM, 23.9% LDM, 20.6% NM, 7.7% RES, and 2.6% PM.

*Habitat use*

We found significant differences in species richness ($F = 5.8$, $p < 0.001$) and abundance ($F = 19.9$, $p < 0.001$) among the six habitats we surveyed in the Park (Table 4). The relative abundance of all species was greatest in low-medium shrub habitat, where the American Tree Sparrow, White-crowned Sparrow, Wilson's and Orange-crowned Warbler reached peak relative abundance. Tall shrub habitats also had large numbers of individuals. In contrast, tundra and mixed forest habitats had relatively low abundance. Tall shrub habitats had the greatest species richness of any of the six habitats we sampled; spruce forests and spruce woodlands also had high richness compared to the other habitats. In contrast, species richness was relatively low in tundra habitats, where some habitat specialists resided including Lapland Longspurs and shorebirds.

Short-distance Neotropical migrants were prevalent in all habitats (Table 3), both in terms of species richness and relative abundance; they were especially common in spruce forests and low-medium shrub habitats. Residents were common in a variety of habitats, although less so in mixed forest stands.

TABLE 4. Habitat use of birds in Denali National Park. Given are the relative abundance (mean number of individuals per station [± SE]) and species richness (mean number of species per station) in six habitat types for on-road routes. Habitats with the same letter are not significantly different ($P > 0.05$; Tukey's multiple comparsion test).

| | Habitat type | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Tundra | Low-medium shrub | Tall shrub | Mixed forest | Spruce woodland | Spruce forest | F | *P* |
| Abundance | $8.5 \pm 0.5^{ac}$ | $14.1 \pm 0.3^{de}$ | $12.6 \pm 0.5^{cde}$ | $9.6 \pm 0.6^{abc}$ | $11.0 \pm 0.6^{bcd}$ | $11.0 \pm 0.7^{abcd}$ | 19.9 | < 0.001 |
| Richness | $4.9 \pm 0.2^{ab}$ | $5.6 \pm 0.1^{abc}$ | $6.3 \pm 0.2^{cd}$ | $5.0 \pm 0.3^{abc}$ | $6.0 \pm 0.2^{bcd}$ | $6.2 \pm 0.4^{bcd}$ | 5.8 | < 0.001 |

More residents were detected in spruce woodlands than other habitats. Nearctic migrants, especially the American Tree Sparrow, reached peak abundance in low-medium shrub habitats. Long-distance Neotropical migrants were most abundant in tall shrubs. There were only two species of paleotropical migrants detected during our surveys; the Arctic Warbler was primarily confined to tall shrub habitats, whereas Northern Wheatears utilized rocky tundra habitats.

## Discussion

The avian community of spruce forests at Denali National Park was generally similar to other areas in central, interior Alaska (West and DeWolfe 1974; Spindler and Kessel 1980). The most abundant species in Black Spruce forests in the Tanana River valley were the Dark-eyed Junco, Swainson's Thrush, White-crowned Sparrow, and Yellow-rumped Warbler (Spindler and Kessel 1980), which corresponded to our findings in Denali. However, redpolls were apparently more common in Denali (this study) than near Northway (Spindler and Kessel 1980), although West and DeWolfe (1974) found that redpolls were abundant in Fairbanks in 1971. We found that redpoll numbers fluctuated rather dramatically in Denali, and surveys conducted by Spindler and Kessel (1980) might have occurred in years (1975 and 1977) when their numbers were relatively low. The Townsend's Warbler (*Dendroica townsendii*) was abundant to the east of our study area (West and DeWolfe 1974; Spindler and Kessel 1980), whereas we did not find this species during our fieldwork in Denali; it has been reported occasionally in the Park (Kertell 1988). In central Alaska, Townsend's Warblers are associated with old-growth, dense canopy spruce forests (Spindler and Kessel 1980) and this habitat does not occur in the Park.

Several species that were relatively uncommon in shrub habitats in Denali were more abundant farther to the east (Spindler and Kessel 1980). For example, the Lincoln's Sparrow (*Melospiza lincolnii*) were the most abundant species in low-medium shrub habitats in the Tanana Valley, whereas they were rare in Denali National Park (this study) and near Fairbanks (West and De Wolfe 1974). In addition, the Common Snipe and Lesser Yellowlegs were much less abundant in Denali compared to farther east. In tall shrubs, the Yellow Warbler (*Dendroica petechia*) was the most abundant species in the Tanana Valley, but it was not nearly as abundant in Denali National Park (this study) or the Fairbanks area (West and DeWolfe 1974).

There is increased interest in birds that breed in the Nearctic region and migrate to the Neotropics due to population declines in a number of species (reviewed by Hagan and Johnson 1992; Rappole and McDonald 1994). Yet no published studies have focused specifically on Neotropical migrants in interior Alaska, even though they constitute the majority of birds breeding in the subarctic and boreal regions (Kessel and Gibson 1978; Spindler and Kessel 1980; Erskine and Davidson 1976). Erskine (1977) estimated that only 18% of the species breeding in the boreal region were permanent residents, whereas permanent residents accounted for approximately 58% of the breeding densities for sites across the lower 48 states (O'Connor 1992). Our results parallel those of Spindler and Kessel (1980) who calculated that permanent residents accounted for only 11% of the individual breeding densities in conifer forests and 4% of the breeding densities in deciduous forests in interior Alaska. We found approximately 8% of the individuals at stations along roadside transects were residents, while 22% of the landbird species detected in the Park were residents. As the majority of birds breeding in interior Alaska are tropical migrants, ecosystem health of the boreal region is clearly dependent on large-scale issues. Residents might be affected by changes solely on their home range (e.g., logging), whereas migrants could be affected by habitat stability on their winter grounds, breeding grounds, or stopover locations (Rappole and McDonald 1994). Therefore, studies hoping to monitor northern avian populations will have consider large-scale issues in their study designs.

The habitat uses we documented for landbirds in Denali were similar to those found in previous research conducted in interior Alaska. Both Spindler and Kessel (1980) and our results suggest that species richness is greatest in tall shrub habitats. However, Spindler and Kessel (1980) found that relative abundance was greatest in tall shrub thickets, whereas our results suggest that low-medium shrub habitats had the greatest abundance. Our results generally concur with Spindler and Kessel (1980), who found that spruce forests and woodlands appear to be among the most important habitats for residents in interior Alaska because relative abundance was greatest in these habitats. However, we also found that tall shrubs were important breeding and foraging habitats for residents, primarily redpolls. Spindler and Kessel (1980) suggested the high species richness and abundance in tall shrubs was due to the combination of high primary productivity and complex habitat structure. In contrast, alpine tundra possibly had low richness and abundance for landbirds due to the relatively simple habitat structure, although most shorebirds are found breeding in alpine tundra. A similar relationship was documented in the Kluane Mountains (Theberge 1976). Therefore, our results, coupled with work by Spindler and Kessel (1980), suggest that shrub habitats should be an integral component in future monitoring efforts in interior Alaska because they provide

important breeding habitats for a large number of species, particularly tropical migrants.

Our analyses of population fluctuations parallel those of Spindler and Kessel (1980). Species that were uncommon had higher fluctuations between years compared to common species. Abundant species, such as the White-crowned Sparrow and American Tree Sparrow, exhibited little annual variation based on both frequency of occurrence and relative abundance estimates. The two exceptions were taxa that were classified as residents, the redpoll and White-winged Crossbill; both are known to be irruptive (Kessel and Gibson 1978). Our surveys did not distinguish whether these annual fluctuations represented actual changes in the population sizes of these uncommon taxa, or more plausibly for the irruptive taxa, a redistribution among alternative areas. More importantly, the results of this study can be used to design a monitoring program for central, interior Alaska. This information on detection probabilities is needed to conduct a power analysis to determine how many survey stations need to be censused annually to monitor avian population trends in this remote region of North America. In addition, it is hoped that this study will help researchers determine what suites of species could be monitored if various habitats were surveyed.

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# Historical Occurrence of Wolves, *Canis lupus*, in the Maritime Provinces

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We conducted a literature review and contacted several museums to determine the historical occurrence of Wolves (*Canis lupus*) in the Maritime Provinces. Although there were many anecdotal sightings prior to 1870, no museum specimens originating from the Maritimes were located. Our review suggested that although Wolves were historically present, they were probably not numerous, and were probably extirpated from the Maritime Provinces between 1870 and 1921.

Key Words: Gray Wolves, *Canis lupus*, abundance, distribution, historical, New Brunswick, Nova Scotia.

Historically, Wolves (*Canis lupus*) were distributed across most of North America. They were extirpated in the southern portion of their range (most of continental United States) by the turn of the century (Nowak 1983; Carbyn 1987). Although healthy Wolf populations exist in Canada and Alaska, the Wolf is considered "vulnerable" by the International Union for the Conservation of Nature (1990).

Within recent years there has been considerable interest in restoring Wolves to their former ranges. Reintroduction efforts are currently underway in Wyoming and Idaho (Fritts 1990; Bath 1992; U.S. Department of the Interior 1994). Reintroduction plans are also being designed for the southwestern United States (Bednarz 1988, 1989). An understanding of the historical occurrence of extirpated populations is important when considering reintroduction into formerly occupied range.

The historical occurrence of Wolves in the northeast portion of the continent has recently been questioned (Kenney *in press*). If viable Wolf populations have not occurred historically within the Maritime Provinces, then establishment of a Wolf population would be considered a new introduction rather than a reintroduction and as a result, the rationale for ecological restoration would disappear.

Despite pro and con arguments for ecological restoration, Wolf reintroduction may be prevented if there is sufficient social resistance. Bath (1987) determined that public willingness to reintroduce Wolves to Yellowstone National Park depended on the social group's interest. For example, although members of the general public were in favor of Wolf reintroduction to Yellowstone, Wyoming Stock Growers were generally opposed, while members of the Wyoming Wildlife Federation were generally in favor of it (Bath 1992).

The purpose of this report was to review available literature and evidence to determine if historic Wolf distribution included the Maritime Provinces and in particular, New Brunswick.

## Methods

We conducted a literature search concerning the historic distribution of Wolves within the Maritime Provinces. We also contacted museums within Canada, United States, and United Kingdom to determine if Wolf specimens and records from the Maritime Provinces existed. Since Wolves never occupied Prince Edward Island (Carbyn 1987) it was excluded.

## Historical Distribution of Wolves

*Anecdotal Evidence*

Indian folklore provides the oldest reference to the Wolf in northeastern North America. To the Micmac Indians of New Brunswick, the Wolf was called Malsum, and was the personification of evil (Leland 1884). To the Malecite Indians of New England, a Wolf howl meant death (Wallis and Wallis 1957).

One of the earliest non-mythical descriptions of the natural history of Acadia (which includes New Brunswick and Nova Scotia) notably did not mention the Wolf in its list of land mammals (Denys 1908). LeClerq (1910) reported that the Wolf was observed in 1691 either on the Gaspe Peninsula, or in northern New Brunswick.

In neighboring New England, Wolves were apparently abundant in the mid to late-1600s. Josselyn (1672: 15) described the Wolves he encountered in New England as follows: "very numerous, and go in companies, sometimes ten, twenty, more or fewer, and so cunning...". He observed three Wolves in August 1638 and two in 1664 (Josselyn 1674).

In Clarke's (1670: 32) list of the "beasts" of New England he mentioned the "ravenous howling Woolf". He described their morphology as "big-boned, thin paunched, deep breasted, having a thick neck and head, prick ears, and a long snout, with dangerous teeth, long staring hair, and a great bush tail".

Two early writers claimed that Wolves were not indigenous to New Brunswick and became numerous only in the mid-1800s (Gesner 1842, 1847; Levinge 1846). Gesner (1842) suggested that Wolves appeared in New Brunswick in 1818. Levinge (1846) also claimed that Wolves were not indigenous to New Brunswick and that they had made their appearance because they were driving White-tailed Deer (*Odocoileus virginianus*) from the eastern United States. He recounted a story about a local resident who slaughtered a Wolf pack in New Brunswick. Baird (1890) recollected a deer hunt in 1846 near Woodstock, New Brunswick, where he and his companions were awakened by the howling of Wolves at night.

Hatheway (1846) also noted an increase in Wolves in the 1840s but he indicated the Wolves had returned to New Brunswick after a period of rarity. Fisher (1838) observed the same low frequency of Wolves before the 1840s. He stated that Wolves were "but seldom seen" in 1836 and 1837. The observed insurgence of Wolves in the 1840s (Gesner 1842, 1847) may only have been temporary because by the 1870's their numbers were apparently again greatly reduced. Adams (1873) reported that the Grey Wolf only occurred within the northern portion of New Brunswick, and Ganong (1908) reported that Wolves were absent or rare after the 1860s. It was shortly after this time period that Wolves were completely extirpated from New Brunswick (Carbyn 1987).

*Commercial Records and Museum Specimens*

Simonds and White supplied settlers on the Saint John River and often received payment with furs (Raymond 1910). From 1764 until outbreak of the revolution in 1774, the Company received two Wolves from Nova Scotia.

In 1792, a bounty on Wolves was instituted in New Brunswick. This act of legislation sought "to encourage the destroying of Wolves" on the basis that "many losses have been suffered by sundry inhabitants of this Province, from the destruction of their Sheep by Wolves, to the great discouragement of the increase of that valuable Stock" (Berton 1838: 236). From 1792 up to and including 1793, a total of five Wolves were bountied (Accounts of the Provincial Treasurer, 1793-1794). The last bounties were paid in New Brunswick for three Wolves in 1862 (Ganong 1908).

Unfortunately, records of the fur trade by the Hudson Bay Company were incomplete for early French harvests and for the northeastern United States (Novak et al. 1987). Therefore, it was not known how many Wolf pelts were acquired in the Maritime Provinces from early human colonization until the Wolf's extirpation in 1870. Although Wolf pelts harvested in Canada were recorded as early as 1699, it was not until 1919 that these were separated by Province. For example, from 1700 until 1775 the numbers of Wolf pelts exported to England increased from 483 to 7608, but the origin of these pelts was unknown (Lawson 1943). However, we do know that approximately £78 of fur (all species) was exported from Nova Scotia in 1765. From 1919 to 1984, reportedly four Wolf pelts were recorded from New Brunswick (Novak et al. 1987); three in 1919 and one in 1921.

During 1995 we contacted the following museums to determine if any contained Wolf specimens which originated from the Maritime Provinces: American Museum of Natural History, New York, N.Y.; James Ford Bell Museum of Natural History, Minneapolis, Minnesota; Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts; National Museum of Natural Sciences, National Museums of Canada [now Canadian Museum of Nature], Ottawa, Ontario; National Museum of Scotland, Edinburgh, Scotland; Natural History Museum, London, England; New Brunswick Museum, St. John, N.B.; Nova Scotia Museum, Halifax, N.S.; Peabody Museum of Natural History, Yale University, New Haven, Connecticut; and Royal Ontario Museum, Toronto, Ontario. Although all of the museums contained Wolf specimens or records of Wolves, none of the specimens were known to originate from the Maritime Provinces.

## Discussion

Available literature suggested that Wolves may have been more abundant in New England than in New Brunswick during the 1600s. In the late 1700s, Wolves also appear to have been uncommon based on the low numbers that were bountied in New Brunswick and the relatively low numbers in relation to Beaver (*Castor canadensis*) pelts that were traded to Simonds and White (Raymond 1910). However, fur trade records were biased towards recording Beaver pelts (Innis 1962). Consequently, use of Wolf pelts as an index of Wolf numbers may have been inaccurate. Although there was insufficient evidence from this early period to draw firm conclusions concerning Wolf abundance, they appeared to be present in relatively low numbers.

The notable lack of actual Wolf specimens or records of Wolf specimens from the Maritime Provinces could have been due to several factors: (1) there were no Wolves, or so few, that specimens were not obtained; (2) fur specimens were not kept because the fur was not valuable or they were exported; (3) the disregard for the animal provided no incentive to collect specimens of it; and (4) speci-

mens prior to extirpation have been lost, destroyed, or deteriorated.

There appears to have been a consensus that Wolves were low in abundance in New Brunswick prior to the 1840s (Fisher 1838; Hatheway 1846), and that they became more numerous during the 1840s (Gesner 1842, 1847; Baird 1890; Hatheway 1846). The period of Wolf scarcity during the late 1700s and early 1800s through to the 1830s (Hatheway 1846) was likely the reason that some people falsely interpreted Wolf re-appearance in the 1840s as a range expansion.

Although we can not verify what canid species early writers actually observed, it appears likely that the identification of the Wolf was probably correct for at least two reasons. First, early colonists were probably familiar with Wolves from their native European countries. Secondly, Coyotes (*Canis latrans*) though present in New Brunswick approximately 2000 years ago (Sanger 1987) did not significantly recolonize the Maritime Provinces until the 1960s (Moore and Parker 1992). Coyotes probably first re-entered Maine in the 1930s (Nowak 1983), while the earliest known "contemporary" coyote in New Brunswick was reported in 1958 (Wolfram 1964).

It was not a moral question to kill Wolves during the early colonization of the Maritime Provinces and New England. Because Wolves killed domestic livestock such as Goats (Josselyn 1674) and Sheep (Berton 1838) they were hunted with vehemence. This may partially account for Wolves becoming relatively scarce prior to the 1840s.

Wolf population fluxes in the Maritime Provinces may also have been caused by changes in prey availability. Gesner (1842) and Levigne (1849) suggested that Wolves came into New Brunswick in pursuit of Deer. During the "little ice age" (1350 to 1870), Caribou (*Rangifer tarandus*) flourished in the Maritime Provinces (F. Scott, Nova Scotia Museum, personal communication). The decline and eventual extirpation of Caribou in New Brunswick in the early 1900s (Squires 1968) may have contributed to the Wolf's disappearance during this period.

Because Wolves were apparently extirpated between 1870 and 1921, evidence for their occurrence in the Maritime Provinces is based on anecdotal observations. However, these types of observations are frequent enough to definitely conclude that Wolves occurred at least sporadically or in low numbers. Whether they occurred in numbers high enough to constitute a minimum viable population can not be ascertained from existing evidence.

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# Keen's Long-eared Bat, *Myotis keenii*, Confirmed in Southeast Alaska

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*Myotis keenii* is apparently restricted to the Pacific coastal forests of northwestern North America. The only documentation of *M. keenii* in Alaska has been a specimen collected in 1887, causing uncertainty about whether this species normally occurs there. We describe two new records which indicate that *M. keenii* may be a regular member of the Southeast Alaska fauna and we provide measurements and information on diet for this poorly documented species.

Key Words: Keen's Long-eared Bat, *Myotis keenii*, Vespertilionidae, southeast Alaska, temperate rainforest.

Of the five vespertilionid species occurring in Southeast Alaska (MacDonald and Cook 1996), the Keen's Long-eared Bat (*Myotis keenii*) was known from a single specimen taken at Wrangell in 1887 (Miller and Allen 1928). Since then, the possibility persisted that it was an accidental occurrence. The original specimen was preserved in alcohol and the skull was not available to confirm its identification. Consequently, its identity remained uncertain until van Zyll de Jong and Nagorsen (1994) used multiple discriminant analysis of five external measurements to diagnose the specimen as *M. keenii*. Because *M. keenii* is distributed throughout coastal rainforests in the Pacific Northwest (van Zyll de Jong and Nagorsen 1994), extensive timber harvest in Southeast Alaska has increased interest in the status of this species.

*Myotis keenii* was previously regarded as conspecific with the Northern Long-eared Bat (*M. septentrionalis*), but now is considered a separate species (van Zyll de Jong 1979). These species are difficult to distinguish from each other, and from the Western Long-eared Bat (*M. evotis*), which is sympatric with *M. keenii* in British Columbia and Washington. The three species can be identified by discriminant function analysis of cranial (van Zyll de Jong 1979) or external (van Zyll de Jong and Nagorsen 1994) measurements.

We provide information on two new specimens of this apparently uncommon species in Southeast Alaska including morphological measurements and diet data. Previously, only 59 specimens of *M. keenii* had been collected and deposited in museum collections. Thirty-five are from the Queen Charlotte Islands of British Columbia, nine from other regions of British Columbia, 14 from western Washington, and one from Wrangell Alaska (Figure 1; van Zyll de Jong and Nagorsen 1994). The known range of *M. keenii* is restricted to Pacific coast rainforests (Nagorsen and Brigham 1993; van Zyll de Jong and Nagorsen 1994), and extends over 2000 km from southwestern Washington to Southeast Alaska (Figure 1). The rarity of this species and lack of ecological data have prompted the British Columbia Ministry of Environment to place *M. keenii* on the provincial "red list" of species under consideration for listing as threatened or endangered (Nagorsen and Brigham 1993). The species has no special conservation status in the United States.

## Methods

During 18 nights in June, July, and August 1993, mist nets were placed in riparian areas on Prince of Wales and Revillagigedo islands in Southeast Alaska. In 1994 bats were collected from a maternity roost of Little Brown Bats (*M. lucifugus*) at Hoonah on Chichagof Island (58°06′N, 135°26′W; Figure 1). Captured bats were prepared as voucher specimens. Specimens and frozen tissue samples are archived at the University of Alaska Museum. Stomach contents collected in 1993 were preserved in 70% ethanol and analyzed for prey volume. Species identity was determined using cranial measurements (van Zyll de Jong 1985) and verified using multiple discriminant analysis (MDA) of 12 cranial measurements (van Zyll de Jong 1979; van Zyll de Jong and Nagorsen 1994) and 5 external measurements (van Zyll de Jong and Nagorsen 1994) listed in Table 1. Further verification was obtained using MDA of the 7 cranial variables (Table 1) which best discriminate between *M. keenii* and *M. evotis* (van Zyll de Jong and Nagorsen 1994).

## Results

On 20 July 1993 an adult male *M. keenii* (UAM 23338) was collected at Turn Creek, in a karst region of northern Prince of Wales Island (56°10′N, 133°18′W), approximately 65 km SW of Wrangell

TABLE 1. Measurements of new *Myotis keenii* specimens.

| Measurements (mm) | UAM 23338 from Turn Creek | UAM 29831 from Hoonah | Mean ± 1 SD. *M. keenii** | Mean ± 1 SD. *M. evotis* from British Columbia* |
|---|---|---|---|---|
| Cranial Measurements: | | | | |
| Skull length† | 14.93 | 14.38 | 14.60 ± 0.219 | 15.45 ± 0.307 |
| Mastoid width† | 6.91 | 6.88 | 7.43 ± 0.135 | 7.76 ± 0.167 |
| Orbital width at lacrimal foramina | 4.45 | 4.75 | 4.30 ± 0.130 | 4.57 ± 0.130 |
| Rostral width† | 2.44 | 2.50 | 3.33 ± 0.093 | 3.63 ± 0.114 |
| Maxillary width at M3† | 5.64 | 5.80 | 5.52 ± 0.121 | 5.85 ± 0.128 |
| Palatal width at P2† | 3.64 | 3.65 | 3.48 ± 0.097 | 3.66 ± 0.141 |
| Maxillary width at I3 | 2.51 | 2.63 | 2.45 ± 0.074 | 2.61 ± 0.071 |
| Maxillary tooth row length | 5.68 | 5.63 | 5.66 ± 0.105 | 6.11 ± 0.155 |
| Length of P4M3† | 3.89 | 3.98 | 3.96 ± 0.072 | 4.33 ± 0.113 |
| Length of M2 | 1.24 | 1.26 | 1.23 ± 0.046 | 1.37 ± 0.052 |
| Width of M2 | 1.68 | 1.48 | 1.69 ± 0.061 | 1.85 ± 0.052 |
| Upper canine width at cingulum† | 0.69 | 0.62 | 0.72 ± 0.026 | 0.83 ± 0.035 |
| External Measurements: | | | | |
| Ear length | 17 | 15 | 18.37 ± 0.491 | 20.38 ± 0.809 |
| Forearm length | 37.28 | 35.35 | 36.70 ± 0.986 | 38.64 ± 1.117 |
| Tibia length | 17.00 | 16.08 | 16.58 ± 0.659 | 17.79 ± 0.681 |
| Metacarpal 3 length | 31.88 | 31.98 | 31.75 ± 0.975 | 34.16 ± 1.266 |
| Metacarpal 5 length | 31.64 | 29.66 | 30.99 ± 0.822 | 33.03 ± 1.142 |

Measurements are defined in van Zyll de Jong (1979).
*From van Zyll de Jong and Nagorsen (1994).
†measurements which best descriminate between *M. keenii* and *M. evotis* (van Zyll de Jong and Nagorsen 1994).

(Figure 1). This bat was captured in a mist net at 23:20 (2 h 10 min after sunset) within 1 m of a limestone cliff and 1 m above the water. Large Western Hemlock (*Tsuga heterophylla*) and Sitka Spruce (*Picea sitchensis*) dominate this riparian area; blueberry (*Vaccinium* spp.) and Devil's-club (*Oplopanax horridus*) dominate the understory. The stomach of the Turn Creek bat contained 40% Trichoptera, 40% Araneae and 20% Diptera; the first indication of dietary habits.

A second adult male *M. keenii* (UAM 29831) was collected on 11 July 1994 from a *M. lucifugus* maternity roost in the attic of an operating fish cannery at Hoonah, approximately 160 km N of the Wrangell specimen (Figure 1). That site is surrounded by large clearcuts and second-growth forest, as well as forested wetlands and riparian areas.

Body and cranial measurements for both specimens, as well as means (± 1 standard deviation) for *M. evotis* from British Columbia and *M. keenii* are summarized in Table 1. Multiple discriminant analysis (MDA) of 12 cranial measurements (van Zyll de Jong 1979) identified the Turn Creek (UAM 23338) and Hoonah (UAM 29831) specimens as *M. keenii* with probabilities of 88% and 85%, respectively. The MDA of 7 cranial measurements which best discriminate between *M. keenii* and *M. evotis* (van Zyll de Jong and Nagorsen 1994) identified both specimens as *M. keenii* with probabilities of 98%. MDA of the 5 external measurements (Table 1) identified both specimens as *M. keenii* (probability 100%), even though the ear of the Hoonah specimen is > 6 standard deviations smaller than the published mean (van Zyll de Jong and Nagorsen 1994).

## Discussion

While only three specimens of *M. keenii* have been recorded in southeast Alaska, little effort has been expended to investigate bat distribution in that region (Parker 1996). *Myotis keenii* may be a year-round resident of Southeast Alaska, although winter records are lacking. All specimens of *M. keenii* have been found in the Pacific Northwest temperate rainforest ecosystem (Walter 1985), a region with relatively mild winters and potentially numerous roost and hibernation sites in caves and trees. Seasonal occurrence of this species, including the documentation of female *M. keenii* and maternity colonies, should be investigated.

Southeast Alaska's temperate rainforests are structurally complex with abundant live trees, snags, and fallen logs of various sizes (Alaback 1991). Such complexity provides loose bark and tree hollows suitable for cavity-roosting species (Bunnell and Allaye-Chan 1984) such as bats (Barclay and Cash 1985; Christy and West 1993; Bradshaw *in press*; Vonhof *in press*). Bats use old-growth forests more frequently than second-growth or clearcut

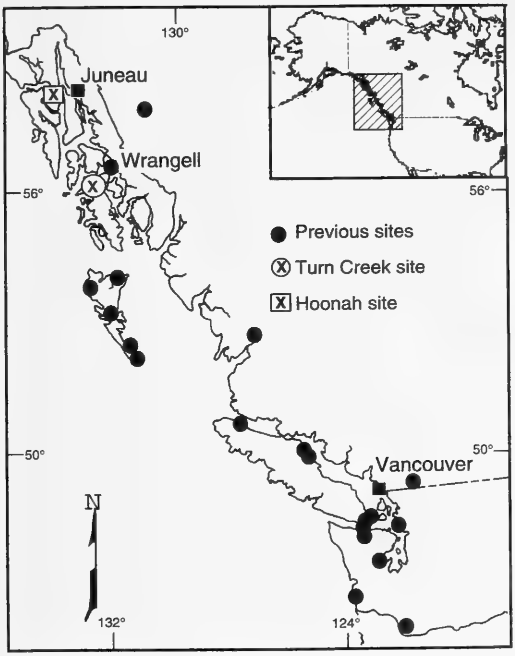


FIGURE 1. Locality records of *Myotis keenii* in the Pacific Northwest. Adapted from data presented by van Zyll de Jong and Nagorsen (1994).

areas in British Columbia, Washington, and Oregon (Barclay and Cash 1985; Lunde and Harestad 1986; Thomas 1988; Christy and West 1993; Bradshaw *in press*; Vonhof *in press*), as well as in Southeast Alaska (Parker et al. *in press*). Caves and crevices are also important bat habitat (Hill and Smith 1984), and over 1769 km$^2$ of cave and crevice-containing karst underlie Southeast Alaska forests (United States Department of Agriculture 1996). These habitat characteristics may be essential to *M. keenii* as the species appears to be restricted to coastal forests (Firman et al. 1993).

Although limited, our data represent the only diet information available for *M. keenii*. The mixture of flying insects (60%) and nonflying spiders (40%) consumed suggests *M. keenii* has a flexible foraging strategy, pursuing prey in flight and gleaning it from surfaces. Similar foraging behavior has been noted for *M. evotis* (Barclay 1991; Faure and Barclay 1994), a closely related species (van Zyll de Jong and Nagorsen 1994). However, more sampling is required to firmly establish this foraging strategy because bat diets tend to change with season and relative abundance of different prey species (Buchler 1976; Fenton and Morris 1976; Anthony and Kunz 1977). The Turn Creek bat was captured in a riparian area, and its stomach contained a high percentage of Trichoptera, a typically riparian insect. Other prey occur throughout old-growth forests and riparian areas indicating that *M. keenii* forages in those areas.

Roost requirements of *M. keenii* are poorly understood (Nagorsen and Brigham 1993), but it probably uses snags, hollow trees, rock crevices and caves (van Zyll de Jong 1985). The capture of the Hoonah specimen from a maternity roost of *M. lucifugus* in an operating fish cannery indicates that this species will roost in a human-occupied building. *Myotis keenii* roosts in association with *M. lucifugus* under rocks heated by a hot spring on Hot Spring Island in the Queen Charlotte Islands of British Columbia (Nagorsen and Brigham 1993). The Hoonah specimen may have been roosting in the noisy cannery due to a lack of undisturbed roosts in the surrounding area. Nonetheless, this species may tolerate periodic disturbance. Bats at the Hot Spring Island colony must abandon their roost periodically when it floods at high tide (Firman et al. 1993). It is uncertain whether these observations reflect a tolerance of disturbance or lack of alternate, suitable roosts.

Forty-two percent of the highly productive forests in Southeast Alaska were clearcut harvested by 1990 (United States Department of Agriculture 1991; 1993), including over 70% of the karstland forests of Prince of Wales and neighboring islands (Baichtal 1995). These forests contain over 30 000 board feet of useable timber per acre (volume class 6 and 7, approximately 348 m$^3$ per hectare; Dilworth 1976). Continued clearcut harvesting may alter forest structure important to bats (Thomas 1988). In fact, bat activity is rare in second-growth forests of Southeast Alaska (Parker et al. *in press*). In view of the limited knowledge of the habitat requirements of *M. keenii*, its apparently strong association with old-growth coastal rainforests, and the continuing harvest of these forests in Southeast Alaska, this species and its habitat requirements warrant further and immediate study.

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# Pumpkin Ash, *Fraxinus profunda*, in Southwestern Ontario

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An addition to the flora of Canada, Pumpkin Ash (*Fraxinus profunda*), is reported from the southwestern counties of Essex, Kent, Elgin and Haldimand-Norfolk. This is a native tree species of swamp forests. The species is most readily distinguished from other ashes by its relatively large samaras 4 – 7.5 cm long.

Key Words: Pumpkin Ash, *Fraxinus profunda*, tree species, new plant record, southwestern Ontario.

Prior to Farrar's (1995) recent report (based on collections of the authors), the range of Pumpkin Ash, *Fraxinus profunda* (Bush) Bush, had not included Canada (e.g., Little 1977; Duncan and Duncan 1988; Preston 1989). Nor has the described range included the state of Michigan or northern Ohio. However, in 1992, botanists with the Ohio Department of Natural Resources found the species in northern Ohio, prompting Michigan botanists to look for it successfully, the same year. In Michigan, Pumpkin Ash was found in the southern two tiers of counties adjacent to Ohio. In October 1992, the senior author examined the Michigan collections at the University of Michigan, Ann Arbor, and was advised by the curator, A. A. Reznicek, to look for the species in very wet, wooded sites in southwestern Ontario. The first site examined in November 1992, at the Devonwood Conservation Area in Windsor yielded the distinctive large samaras of Pumpkin Ash. Subsequent examinations of swamps across southwestern Ontario have revealed the species to be a common associate of swamp communities. It is remarkable that such a distinctive tree should have escaped attention. Ash trees which, in the past, the authors and others (W. Balkwill, personal communication) found difficult to identify have been found, upon re-examination, to be Pumpkin Ash.

The described range of Pumpkin Ash has expanded considerably as familiarity with the species has increased. Bush, the accepted author of the species, published the range in 1894 as Dunklin and New Madrid counties in Missouri. In 1897, he extended the range to Arkansas and Florida. Britton, in 1908, described the range as "known to occur from Missouri, Illinois, and eastern Arkansas to Virginia and Florida". Deam (1921) located it in the southwestern counties of Indiana and by 1922 Sargent had it in western New York, southern Indiana and Illinois, western Kentucky and south to Louisiana and Florida. In 1953, Little gave a similar range but included southern Ohio. Braun (1961) mapped it in just two counties of southwestern Ohio near the Ohio River. The Pumpkin Ash range map in Little (1977) shows disjuncts through central and northern Indiana and southwestern Ohio, but nothing in western New York. Apparently, every range map published since 1977 (Elias 1980; Duncan and Duncan 1988; Preston 1989; McCormac 1993) is based on the map Little (1977).

In Ontario, the range, based on collections and observations made since 1992, is restricted to an area west of Turkey Point, Regional Municipality of Haldimand-Norfolk (Table 1), in the Niagara Section of the Deciduous Forest Region as defined by Rowe (1977), (Figure 1). The species should be looked for in swamps near Lake Erie east of Turkey Point.

The nomenclatural history of Pumpkin Ash is interesting. Bush (1894) described it as a variation of *Fraxinus americana*, *F. americana profunda*, based on differences "in the strong pubescence of the shoots, the large size of the leaves, and the very large fruit, the shaft of which is strongly six-sided". Bush revised his opinion in 1897 (Bush 1897) and made the variety a full species, *F. profunda*. Synonyms have included *F. michauxii* Britton (1905) and *F. tomentosa Michx. f.*, the latter proposed by M. L. Fernald in 1938, based on an illustration and description published by Francois André Michaux in 1813. *F. tomentosa* was adopted subsequently by many authors (Fernald 1950; Braun 1961; McCormac 1993), but it is an illegitimate name as noted by Little (1953).

Pumpkin Ash is a medium to tall tree, up to 40 metres (Sargent 1933; Fernald 1950). It is a hexaploid with n = 138 versus n = 46 for most other ash species in eastern North America (Wright 1957). This higher ploidy is reflected in the large size of the species' organs; the leaves, for example, are 23-45 centimetres in length. Leaflets number 7 or occasionally 9, are usually tomentose when unfolding, but later glabrous and often glossy above. The leaflet

TABLE 1. Pumpkin Ash collections in Ontario. The locations are mapped in Figure 1.

| Location | Collector Collection No. | Collection Date |
|---|---|---|
| 1 Springwater Conservation Area, Elgin County UTM 968 322 (map 40I/11) | Ian D. MacDonald 14432 UWO 40444 (identified as *F. pennsylvanica*) | 3 September 1983 |
| 2 Lot C, Conc. II, Gosfield South Township, Essex County UTM 502 581 (map 40J/2) | G. E. Waldron MICH | December 1992 |
| 3 Canard River, 1.4 km SE Gesto, Essex County UTM 458 655 (map 40J/2) | A. A. Reznicek M. J. Oldham 14665, MICH, TRTE | 18 May 1993 |
| 4 Maidstone Conservation Area, Essex County UTM 522 747 (map 40J/2) | A. A. Reznicek, G. E. Waldron M. J. Oldham 14946, TRTE | 15 June 1993 |
| 5 Rondeau Provincial Park, Kent County UTM 295 835 (map 40I/5) | M. E. Gartshore MICH | 22 June 1993 |
| 6 West Lorne, Elgin County UTM 516 087 (map 40I/12) | M. E. Gartshore MICH | 23 June 1993 |
| 7 4 km W West Lorne, Elgin County UTM 455 168 (map 40I/12) | M. E. Gartshore MICH | 23 June 1993 |
| 8 Lot II, Conc. XIII, Aldborough Township, Elgin County | Wm. Stewart 3684 UWO 43417 Identified as *F. tomentosa* (= *F. profunda*) | 27 June 1993 |
| 9 7 km. E. Eagle, Elgin County UTM 547 125 (map 40I/12) | R. Vanderjeugd M. J. Oldham 15917, MICH, TRTE | 10 July 1993 |
| 10 Jeanette's Creek Woods, Kent County UTM 916 864 (map 40J/8) | M. J. Oldham 15390 MICH | 12 August 1993 |
| 11 Leamington White Oak Woods Environmentally Significant Area, Essex County UTM 736 602 (map 40J/2) | M. J. Oldham 15418 MICH, TRTE | 14 August 1993 |
| 12 Brunet Park, LaSalle, Essex County UTM 312 786 (map 40J/3) | G. E. Waldron MICH | 15 September 1993 |
| 13 6 km NNW Rodney, Elgin County UTM 422 188 (map 40I/12) | A. A. Reznicek M. J. Oldham 15860, MICH | 29 September 1993 |
| 14 Conc. II, South Walsingham Township Regional Municipality of Halidmand-Norfolk UTM 405 205 (map 40I/9) | M. E. Gartshore Photo Fax NHIC | 3 June 1994 |
| 15 Tilbury West Conservation Area, Essex County UTM 771 776 (map 40J/1) | M. J. Oldham 16413 | 18 July 1994 |
| 16 Fish Point Provincial Park Reserve, Pelee Island, Essex County UTM 604 218 (map 40G/10) | S. Reznicek A. A. Reznicek 10064 MICH, DAO | 12 July 1995 |

margin is entire or slightly serrate. Unlike Red Ash, but similar to White Ash, the leaflets have distinct petiolules without the blade decurrent nearly to the base (Figure 2). The twigs are thick and, at least when young, pubescent. The trunk in forest-grown trees is long and slender from a flaring or swollen, and hence pumpkin-like, base from which the tree gets its popular name (Figure 3). The swollen base is seen on some Ontario specimens, but this trait is apparently more commonly exhibited by the species in the swamps of the southern United States.

The bark on older trees most commonly develops into solid, continuous ridges similar to those of White Ash and not flaky, broken ridges like those of Red Ash. Trees of Pumpkin Ash can be located by looking for "White" Ashes growing, atypically, in swamps.

Pumpkin Ash is dioecious. The staminate flowers are said to have a "campanulate obscurely 4-toothed calyx; stamens two or three; pistillate calyx larger, deeply 4-lobed, accrescent and persistent" (Hough 1936). It is the fruit which provides the best character for identifying this species in the field. The samaras are the largest of any native ash, ranging from 4–7.5 cm in length with a wing 6–14 mm broad and narrowly decurrent to below the middle of the seed-bearing portion. The persistent calyx is similarly large, ranging from 2–5 mm in size (usually 4 mm in

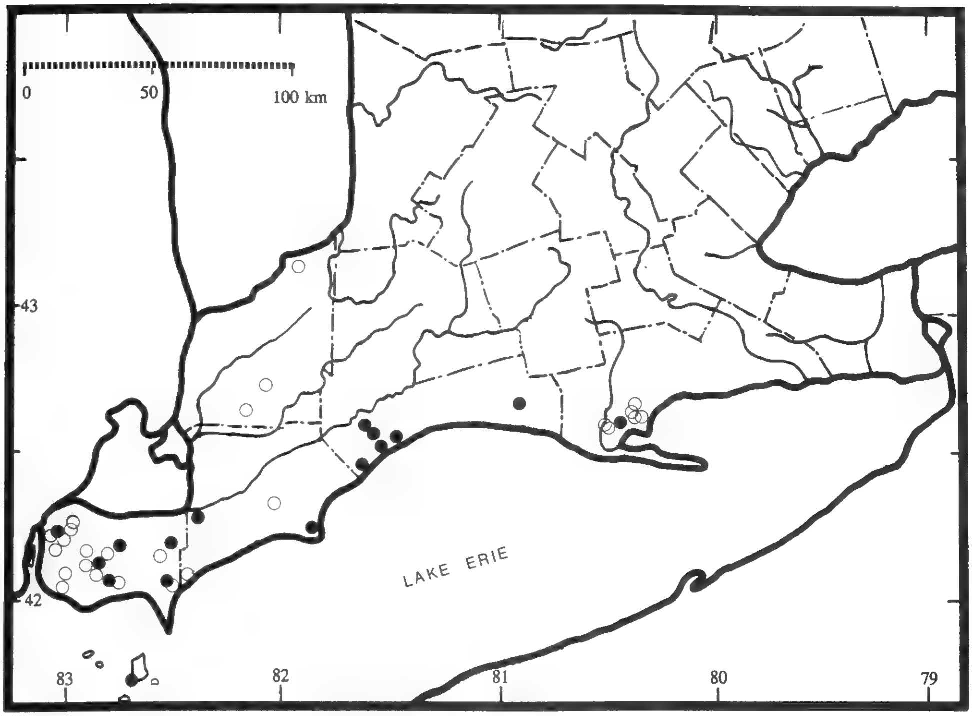


FIGURE 1. Ontario distribution of Pumpkin Ash, based on collections ●, and observations ○.

FIGURE 2. Fruiting branch of Pumpkin Ash.

FIGURE 3. Swollen base of an Ontario Pumpkin Ash.

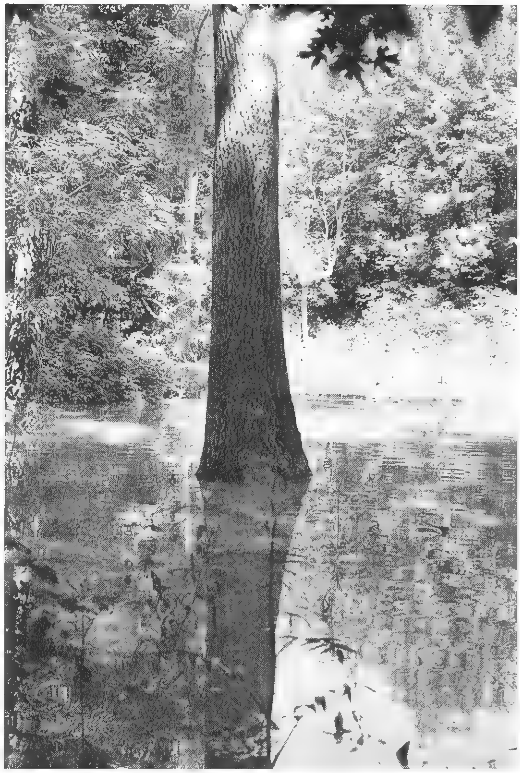

FIGURE 5. A Pumpkin Ash tree growing in an oxbow pond along the Canard River, Essex County, Ontario.

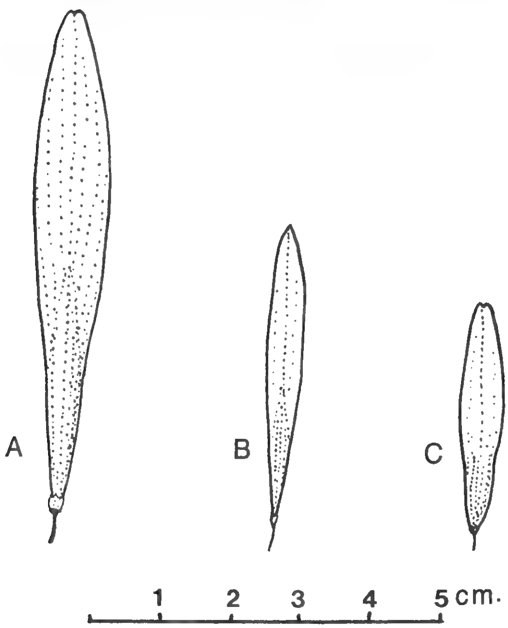


FIGURE 4. Fruits (samaras) of three ash species: (A) Pumpkin Ash, *F. profunda*; (B) Red Ash, *F. pennsylvanica*; (C) White Ash, *F. americana*.

Ontario material). The relative size of the samara is shown in Figure 4. In some populations, the samaras are released over a long period from November into April; in others, they are released soon after maturing in October.

Seed collected in Ontario germinates readily into vigorous seedlings without pretreatment, regardless of the time of collection. Seedlings and small size classes can be found in stands with Pumpkin Ash.

Pumpkin Ash usually grows in low areas where water stands at least part of the year (Figure 5). Its associates in Ontario include: Silver Maple, *Acer saccharinum*; White Elm, *Ulmus americana*; Pin Oak, *Quercus palustris*; Swamp White Oak, *Q. bicolor*; Shumard Oak, *Q. shumardii*; Red Ash, *F. pennsylvanica*; Eastern Cottonwood, *Populus deltoides*; Black Gum, *Nyssa sylvatica*; willows, *Salix* spp. and Buttonbush, *Cephalanthus occidentalis*. Many of these communities would have previously (up to 1950s) been dominated by White Elm.

The species is also found on mesic sites in Ontario; a fact which may be explained by the artificial drainage of most of the now largely agricultural landscape. Early surveyors noted much wetter conditions. Patrick McNiff at Sandwich (near Windsor) in

1793 writes of a line he ran "S28d, 30E. the distance of Six Concessions, at which distance the land proved so wet and swampy could not continue...". Thomas Smith (1805-1806) describes what is presently a relatively dry and arable portion of Essex County thus: "In the three townships of Colchester, Gosfield and Mersea not above the third part of them is habitable – extensive swamps and morases [sic] perilous places – thickety and water throughout stagnant and ruinous." Mahlon Burwell in 1816 writes of surveying in Essex County: "in the early part of summer it was almost impossible to survey on account of the depth of water in the rear parts of the townships." Now the areas described above are all much drier but Pumpkin Ash still thrives there.

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# The Occurrence of the Night Snake, *Hypsiglena torquata*, in British Columbia, with Comments on its Body Size and Diet

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In Canada, the Night Snake (*Hypsiglena torquata*) is apparently restricted to the hot, dry southern interior of British Columbia and is one of this country's most poorly known snakes. Its small size, cryptic behaviour, restricted range in the province, and similar appearance to other syntopic species probably account for the small number of observations of this species to date. We summarize data on 14 specimens of the Night Snake found in British Columbia since 1980. Measurements of body size of these specimens are similar to those from Idaho and support the hypothesis that body size in this species is greater in the northern part of its range. Observations of feeding habits in captivity suggest that this species is a generalist predator on amphibians and reptiles. A single feeding record from the field indicates that large prey, up to at least one-third of the snake's body mass, are sometimes taken.

Key Words: Night Snake, *Hypsiglena torquata*, distribution, body size, food, British Columbia.

On 28 September 1980, one of us (HL) found the first Canadian specimen of the Night Snake, *Hypsiglena torquata*, near Kaleden (49°24′ N, 119°35′ W), British Columbia, about 45 km N of the U.S. border. Since then, to our knowledge, at least thirteen other specimens have been found in British Columbia, all but two south of the first sighting. Although the occurrence of *H. torquata* in British Columbia, based on HL's specimen, has been noted in four field guides (Nussbaum et al. 1983; Cook 1984; Gregory and Campbell 1984; Stebbins 1985), it has otherwise been discussed only in a magazine article (Valadka 1992), in an unpublished document (Bufo Inc. 1993. Report on the status of the Night Snake (*Hypsiglena torquata*) in British Columbia. Submitted to Wildlife Branch, Ministry of Environment, Lands and Parks, British Columbia), and in government reports (e.g., Orchard 1984). Because it has not yet been formally reported in the scientific literature, we herein summarize much of the available data on this species in British Columbia.

All but one of the specimens of *H. torquata* in British Columbia have come from the southern Okanagan Valley, which is shrub-steppe habitat characterized by hot, dry summers, with near-desert conditions in some areas; the remaining specimen was found in the Similkameen Valley, west of the Okanagan, near Keremeos (49°12′ N, 119°49′ W), which has similar vegetation and climate. The most northerly specimens, both found by MJS, have come from the vicinity of Penticton (49°30′ N, 119°35′ W); the most southerly specimens have been caught about halfway between Oliver (49°11′ N, 119°33′ W) and Osoyoos (49°02′ N, 119°28′ W).

Data on all 14 specimens are summarized in Table 1. These data either were extracted from our own records or from those presented by Bufo Inc. (1993). In two instances, our data were different from those presented in that report: Bufo Inc. recorded SVL and TL (see Table 1) of the 28 September 1980 specimen as 362 and 431 mm and the SVL of the 8 July 1993 specimen as 390 mm. In the latter case, our measurement (Table 1) is supported by a photograph and is, in any case, much more consistent with the animal's large body mass. Also, our record of the 20 July 1991 specimen as a male (Table 1) conflicts with Valadka's (1992) report of the same specimen as a female. Most live specimens have been found either under rocks or in traps and most have been released. Three specimens have been found dead (Table 1).

The specimens retained in collections (Table 1), as well as others that we have found, match the description of *H. ochrorhynchus deserticola* given by Tanner (1944), subsequently treated as *H. torquata deserticola* (Bogert and Oliver 1945; Dixon 1965), the Desert Night Snake, which is the expected subspecies in this area (Nussbaum et al. 1983). Photographs of the other Night Snakes caught in British Columbia also support this designation (noted in Table 1). Wright and Wright (1957) show a photograph of a specimen from Vantage, Washington,

TABLE 1. Data and other information on fourteen specimens of *Hypsiglena torquata* found in British Columbia. HL = H. Lacey, SA = S. Alexander, PTG = P. Gregory, CHS = C. Shewchuk, LAG = L. Gregory, MJS = M. Sarell, MA = M. Allison, GK = G. Klein, SK = S. Klein, CM = C. McNaughton, FRC = F. Cook, HP = H. Parsons, OND = O. Dyer, SVL = snout-vent length, TL = total length, RBCM = Royal British Columbia Museum, BCMELP = British Columbia Ministry of Environment, Lands and Parks.

| Date | Collector | Sex | SVL/TL (mm) | Mass(g) | Approximate Location | Details of capture | Comments |
|---|---|---|---|---|---|---|---|
| 28 September 1980 | HL | F | 328/395 (405 TL live) | - | Near Kaleden | In open on talus slope covered with dry pine needles | Preserved in RBCM (Acc. No. 1606); measured by FRC (see text) |
| 6 June 1988 | SA (with MJS) | F | 417/489 | - | Near Vaseux Lake | Under a rock near a talus slope | Maintained in captivity, photographed, and released (HP, personal communication) |
| 13 June 1989 | GK | F? | 180/211 | - | North of Oliver | Under a rock | Measured, photographed, and released |
| 20 July 1991 | MJS | M | 471/568 | - | North of Oliver | Caught in funnel trap | Measured, photographed, and released (reported in Valadka 1992) |
| 9 August 1991 | SK | M | juvenile | - | North of Oliver | Found dead and partially eaten by cat | Preserved at BCMELP, Penticton |
| 5 September 1992 | PTG (with CHS and LAG) | F | 483/- | 26 | Between Oliver and Osoyoos | Under a rock | Contained neonate rattlesnake in stomach; kept in live collection at University Victoria until death in spring 1995, then preserved there [Accession Number 1396] |

*Continued*

TABLE 1. (Continued)

| Date | Collector | Sex | SVL/TL (mm) | Mass(g) | Approximate Location | Details of capture | Comments |
|---|---|---|---|---|---|---|---|
| 25 May 1993 | CM | - | - | - | Near Okanagan Falls | - | - |
| 8 July 1993 | MA | F | 525/605 | 38.5 | Near Keremeos | Road-kill | Measured, photographed and preserved by CHS, who reckoned that it had been dead at least 12 h before measurement; specimen at BCMELP, Penticton |
| 15 August 1993 | CHS | M | 360/430 | 13 | Between Oliver and Osoyoos | Caught in funnel trap | Kept in live collection at University of Victoria until death in spring 1996, then preserved there [Accession Number 1428]. |
| 12 June 1994 | MJS | F | - | - | Near Penticton | Under a rock | Photographed and released |
| 17 June 1994 | MJS | M | - | - | Near Penticton | Under a rock | Photographed and released |
| 1 September 1994 | MJS | F | 465/570 | 59 | Near Vaseux Lake | Caught in funnel trap | Photographed and released |
| 3 September 1994 | CHS | M | 430/515 | 26 | Between Oliver and Osoyoos | Caught in funnel trap | Photographed and released |
| 30 May 1995 | OND | - | 182/215 | - | Near Okanagan Falls | Road-kill | Measured and preserved at BCMELP, Penticton |

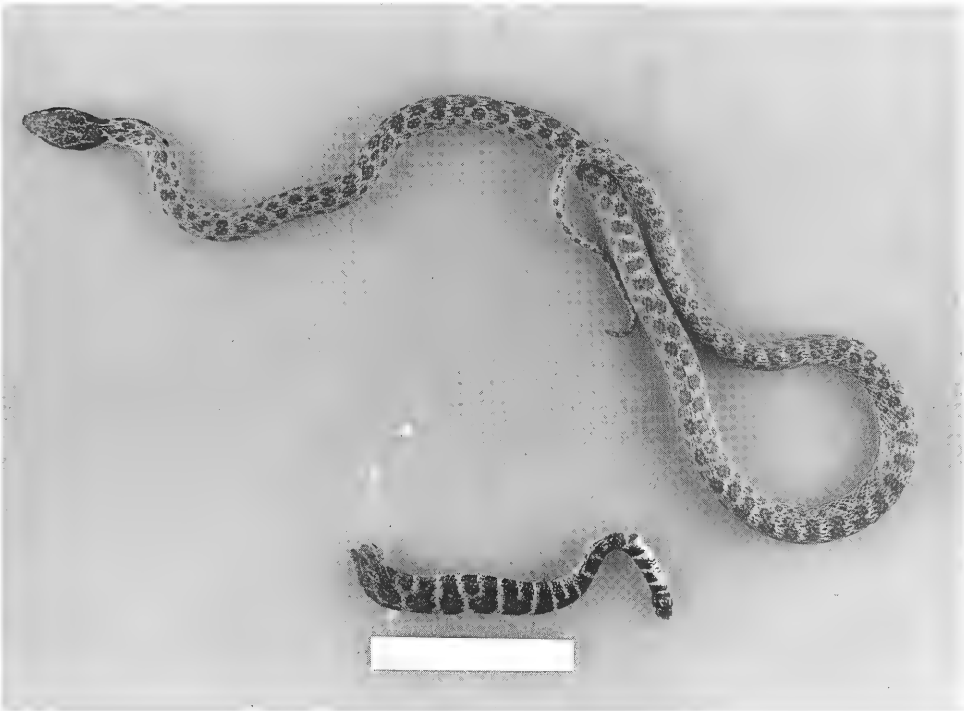

FIGURE 1. Specimen of *Hypsiglena torquata* caught on 5 September 1992 beside posterior portion of *Crotalus viridis*, which it regurgitated. Photo by Tom Gore on 15 January 1993.

which, not surprisingly, closely resembles those seen in British Columbia.

Scale counts have been made for only two of the British Columbia specimens: F. Cook (personal communication) examined HL's original specimen and recorded loreals 1-1, preoculars 1-1, postoculars 2-2, supralabials 9-8, infralabials 11-10, dorsal scale rows 21-23-15, ventrals 194, caudals 49, anal divided; H. Parsons (personal communication) described the second known specimen as having dorsal rows 20-21-17, ventrals 186, subcaudals 47 (the first 19 being single). These values are generally similar to those reported for *H. t. deserticola* by Tanner (1944) and Wright and Wright (1957). Given the number of specimens now accumulating in collections (Table 1), a thorough study of variation in scale patterns may eventually be possible.

Presumably, the range of the Night Snake is continuous from at least Penticton south through the Okanagan Valley to the known part of its range in Washington state. The habitat throughout this area is characteristically dry, with extensive rock outcroppings and talus slopes, and has hot summer weather. Svihla and Cox (1940) reported an 800 km northward extension of the Night Snake's range to Vantage, Washington, but Nussbaum et al. (1983) show only one additional locality (near Pateros, about 105 km south of the Canada-U.S.A. border) between Vantage and HL's first specimen in Canada at Kaleden. Since then, MJS has found a specimen, recorded by McAllister (1995), at Keller Ferry (about 90 km east of Pateros and 117 km south of the international border). Thus, a considerable gap still exists in the species' known range in British Columbia and Washington. Undoubtedly, the snake's secretive and mainly nocturnal habits make it difficult to find. Furthermore, its small size and potential resemblance to small specimens of four other syntopic snakes (Western Terrestrial Garter Snake, *Thamnophis elegans*; Gopher Snake, *Pituophis melanoleucus*; Racer, *Coluber constrictor*; Western Rattlesnake, *Crotalus viridis*), all of which may be blotched (at least when young), may have caused it to be overlooked by the casual observer. Nonetheless, it is somewhat surprising that the Night Snake was never reported by experienced naturalists, including herpetologists, active in the southern Okanagan in the decades preceding the

**Pseudacris regilla* in one recent phylogeny. See Hedges 1989.

first record of the species. It is possible that the Night Snake has expanded its range into British Columbia only recently, but this would represent a rather rapid colonization and therefore seems unlikely.

According to Nussbaum et al. (1983), *H. torquata* rarely exceeds 460 mm in *total* length, although these authors also report that females in southeastern Idaho may reach 525 mm SVL. A gravid female found in Idaho by J. Beck (personal communication) was 530 mm SVL (620 mm TL) and weighed 49 g. Diller and Wallace (1986) found maximum SVL's of males and females in southwestern Idaho to be 400 and 523 mm, respectively; they suggested that northern *Hypsiglena* are larger than more southerly conspecifics. Our data on body sizes of British Columbia specimens are consistent with this hypothesis. Diller and Wallace (1986) also inferred that males reached sexual maturity at about 290 mm SVL and females at about 400 mm. On this basis, we judge that all but two of the specimens found so far in British Columbia were sexually mature.

The natural history of the Night Snake is poorly known, the only substantial report being that of Diller and Wallace (1986). Of particular note here is the observation that the specimen captured by PTG, CHS, and LAG (Table 1) regurgitated the partly digested posterior half of a neonate Western Rattlesnake (Figure 1). From data on numbers of ventral scutes presented for *Crotalus viridis* by Nussbaum et al. (1983) and Campbell and Lamar (1989) and the length of the remaining part of the rattlesnake (University of Victoria Accession Number 1396), we estimated that this prey item was 236-285 mm SVL, well within the range of sizes at birth reported by Macartney et al. (1990). We used mass-SVL regression equations from Macartney et al. (1990) to estimate that this rattlesnake weighed from about 9-14 g. Thus, the ratio of mass of prey to mass of predator was approximately 0.35-0.54. Although well short of the large relative sizes of prey eaten by some elapids and viperids (Greene 1983), this is a very large prey item, and is substantially larger than any reported previously for *Hypsiglena*, to our knowledge. Diller and Wallace (1986) found that Night Snakes in Idaho ate small lizards and their eggs, anurans, and insects.

Although no stomach samples were obtained from any other specimens, we suspect that *Hypsiglena* in British Columbia is a generalized predator on amphibians and reptiles. Numerous captive-feeding observations were obtained from the two specimens held by PTG and the single specimens held by HL and H. Parsons (personal communication). Prey that have been eaten readily by one or more of these snakes are Long-Toed Salamanders (*Ambystoma macrodactylum*), Western Toads (*Bufo boreas*), Pacific Tree Frogs (*Hyla regilla**), Wall Lizards (*Podarcis muralis*), and Northwestern Garter Snakes (*Thamnophis ordinoides*). The specimens maintained by PTG have eaten either live or dead prey of most types, including chopped-up frogs (*H. regilla* and Red-Legged Frogs, *Rana aurora*), but they have been especially responsive to live lizards or snakes; although one of these snakes also ate a live recently born mouse shortly after capture, we did not have further success with this kind of food. Other rejected prey include Northern Alligator Lizards (*Elgaria coerulea*) and nestling swallows (Parsons, personal communication), goldfish, mealworm larvae, and a dead Ensatina Salamander (*Ensatina eschscholtzii*). Night Snakes are rear-fanged colubrids with toxic saliva (McKinstry 1978); although they are reported to subdue their prey with this toxic saliva (Goodman 1953; Wright and Wright 1957; McKinstry 1978; Nussbaum et al. 1983), we have not unequivocally observed this aspect of prey capture. A likely prey of *Hypsiglena* in southern British Columbia is the Western Skink, *Eumeces skiltonianus*, which is reasonably common in at least two of the sites at which Night Snakes have been found.

The range of *Hypsiglena torquata* in British Columbia is possibly larger than described here. Habitat requirements of Night Snakes seem to overlap with those of Western Rattlesnakes, Gopher Snakes, and Racers, all of which occur the full length of the Okanagan Valley and also in the Thompson River Valley. We encourage biologists and other naturalists to be vigilant for the Night Snake and to collect basic data (body size, sex, reproductive condition, habitat, stomach contents [obtainable by palpation]) on it so that we can better understand its natural history. We would be pleased to receive additional records of sightings or captures of this interesting snake.

## Acknowledgments

We thank Harry Parsons (Bufo Inc., West Vancouver) and Jonathan Beck (Idaho State University, Pocatello) for their observations, Francis Cook (then of the National Museum of Natural Sciences, now Canadian Museum of Nature, Ottawa) for his confirmation of the specimen caught by HL and scale counts, and Tom Gore for photography. Bill Preston, Manitoba Museum of Man and Nature, Winnipeg, made interesting comments on an earlier draft, particularly on previous lack of records and possible feeding on skinks. Figure 1 is dedicated to the spirit of Harry Greene, which inhabits all those fascinated by the stomach contents of snakes. PTG thanks the Natural Sciences and Engineering Research Council of Canada for supporting his field studies of snakes. CHS and PTG also thank the World Wildlife Fund and the British Columbia Ministry of Environment, Lands and Parks for their support.

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# Small Mammals of Even-aged, Red Alder - Conifer Forests in Southeastern Alaska

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Hanley, Thomas A. 1996. Small mammals of even-aged, Red Alder - conifer forests in southeastern Alaska. Canadian Field-Naturalist 110(4): 626–629.

Densities, body weights, age and sex ratios of small mammals in three 31- to 36-year-old, even-aged, Red Alder - Sitka Spruce - Western Hemlock (*Alnus rubra - Picea sitchensis - Tsuga heterophylla*) stands were compared with those in adjacent old-growth Western Hemlock - Sitka Spruce stands. Mammals were censused by snap-trapping each stand with 100 traps for three consecutive nights in late May-early June and again in late July-early August. Three species of small mammals were captured: Sitka Mouse (*Peromyscus sitkensis*), Long-tailed Vole (*Microtus longicaudus*), and Common Shrew (*Sorex cinereus*). Mice were more abundant than voles and shrews in both trapping periods. Significant differences ($P<0.05$) between even-aged and old-growth stands occurred only during the second period: density of shrews was greater in even-aged than old-growth stands; body weights of juvenile mice were greater in even-aged than old-growth stands (25.3+1.1 vs. 20.5+1.1 g); and voles were more commonly associated with alder than conifer patches within even-aged stands. Mice densities were significantly correlated with estimated total understory biomass across all stands in both trapping periods ($r_S=0.83$ in both, $P<0.05$, one-tailed). Results indicate that even-aged, Red Alder - conifer stands may be valuable small mammal habitat in southeastern Alaska and that Red Alder may be an especially important component of young stands. Clearcut logging that favors Red Alder might have significantly better consequences for some small mammal species than does high-lead clearcut logging that discourages alder.

Key Words: Sitka Mouse, *Peromyscus sitkensis*, *Peromyscus keeni*, Long-tailed Vole, *Microtus longicaudus*, Common Shrew, *Sorex cinereus*, Red Alder, *Alnus rubra*, Sitka Spruce, *Picea sitchensis*, Western Hemlock, *Tsuga heterophylla*, forest management, wildlife habitat, clearcut logging, Alaska.

Clearcut logging of old-growth, Sitka Spruce - Western Hemlock (*Picea sitchensis - Tsuga heterophylla*) forests in southeastern Alaska is believed to have broadly negative consequences for wildlife habitat (Schoen et al. 1981, 1988; Samson et al. 1989). The principal reason is because secondary succession following clearcut logging is believed to result in a very depauperate understory once the conifer canopy of the regenerating stand closes (closed canopy from about ages 25 through 150 years; Alaback 1982). Much research has been directed at the implications for Sitka Black-tailed Deer (*Odocoileus hemionus sitkensis*) (e.g., Wallmo and Schoen 1980; Hanley et al. 1989; Hanley 1993). Less attention has been given to small mammals.

Van Horne (1981, 1982a, 1982b) studied the population dynamics and ecology of the Deer Mouse (*Peromyscus maniculatus*) and Long-tailed Vole (*Microtus longicaudus*) in seral stages of Sitka Spruce - Western Hemlock forests on Prince of Wales Island, southeastern Alaska. Her stands were aged 2-5, 7-9, 23-25, and 190+ years but did not include a dense, closed-canopy stage. Van Horne's 23- to 25-year-old stand had a very high-biomass understory with conifers only beginning to close-in. It was her most productive habitat for mice; the 7- to 9-year-old stand was most productive for voles. Van Horne cautioned, however, that she "would anticipate a drop in population size near the time of [conifer] canopy closure" (Van Horne 1981: page 1058). She based her reasoning on the general pattern of secondary succession described by Alaback (1982).

The depauperate understory of closed-canopy, even-aged spruce-hemlock stands is a common phenomenon on upland sites in southeastern Alaska (Harris and Farr 1974; Alaback 1982; Deal and Farr 1994). It has become the "typical" pattern in recent decades since the widespread use of high-lead clearcut logging, where logs are transported through the air and soil disturbance is minimized. Earlier clearcut logging, however, involved considerable soil disturbance and resulted in much Red Alder (*Alnus rubra*) establishment and dominance of logged sites. Those sites have largely been ignored in analyses of secondary succession in southeastern Alaska.

Understory of Red Alder-dominated, even-aged second-growth stands appears to be quite different from that of the general pattern for pure conifer stands. Hanley and Hoel (1996) found no significant difference in total understory biomass of 40-year-old Red Alder riparian forests (260 ± 9 kg/ha) compared with old-growth upland (417 ± 93 kg/ha) and

old-growth riparian (295 ± 3 kg/ha) forests. Similarly, R. L. Deal (unpublished data) found total understory canopy coverage of even-aged, Red Alder - conifer stands more than six times greater than that of a nearby even-aged, spruce-hemlock stand (111 ± 22 vs. 18 percent). Few quantitative data are available for understory biomass of Red Alder stands in southeastern Alaska, but general observations indicate that patterns described above are widespread throughout the region. Such stands, therefore, might provide better habitat for small mammals than age, alone, would indicate.

The purpose of this study was to census the small mammal populations of three even-aged, Red Alder - conifer stands in comparison with those of three nearby old-growth stands. Similar aged, pure conifer stands were not present in or near the study area.

## Methods

The study took place in the Crab Bay area of Chichagof Island, Alaska (57°45′ N, 135°15′ W), within 500 meters of the beach. Three Red Alder - conifer stands, resulting from clearcut logging of predominantly Sitka Spruce on old landslide colluvial fans, were the focus of the study. The stands were ages 31, 36, and 36 years when the study took place. They were widely separated, two on the south shore about 2 km apart and the third across the bay from the others. Each stand was approximately 30-40 ha. All three stands were surrounded by old-growth forest except at the beach. The old-growth stands varied from relatively dense canopy, high timber volume to relatively open canopy, low to medium timber volume, and they occurred on steeper slopes than did the even-aged stands.

Small mammals were censused by snap-trapping with museum-special traps baited with rolled oats. Trapping was conducted twice during the summer of 1994: first 27 May through 5 June, and then again 28 July through 5 August. An old-growth stand near each even-aged stand was trapped simultaneously to provide a reference for comparison. The old-growth stands were not considered paired-samples with their even-aged counterpart, however, because site characteristics differed. Trapping in each of the six stands was conducted within a 250 × 60-m grid. The grids were >200 meters from the stand edge and from each other between the two trapping periods. The traps were arranged in a grid of four lines, spaced at 10-m intervals on each line and 15-m intervals between lines. Each grid was trapped with 100 traps for three nights. Traps were baited in evening and checked in morning. All snapped traps were counted each morning, and empty snapped traps were excluded from calculations. Animal densities were expressed as number per 300 trap nights.

All captured animals were identified to species and collected on-site, taken to the field station and weighed, sex determined, and aged (adult or juvenile, based on pelage coloration) (shrews were not weighed, sexed, or aged).

Within-stand variation in animal density was studied in the even-aged stands by assigning each trap station to one of three categories of predominant overstory type (within a 10-m radius): alder, conifer, or mixed. Between-stand variation in habitat conditions was assessed by visually estimating total vascular understory biomass (kg/ha) of each stand and ranking all six stands within each of the two trapping periods. Admittedly, these were very crude estimates, but the ranking of stands was probably reasonably accurate.

Data from the two trapping periods were analyzed separately. Statistical tests (all conducted at an alpha level of 0.05) were the following (Zar 1974): Student's t-test for all comparisons between forest types (even-aged vs. old-growth) and between sex or age classes; chi-square analysis for goodness-of-fit for within-stand associations (alder, conifer, or mixed) in even-aged forest; and Spearman's rank correlation for between-stand comparisons of animal density with total understory biomass.

## Results and Discussion

A total of 319 animals within three species were captured: 200 mice (*Peromyscus sitkensis*; but note that Hogan et al. [1993] have recently suggested populations previously identified as *P. sitkensis* and *P. maniculatus* in southeastern Alaska should be designated as *P. keeni*), 71 voles (*Microtus longicaudus*), and 48 shrews (*Sorex cinereus*). No significant differences between even-aged and old-growth stands occurred in densities for mice or voles in either trapping period (Table 1). Densities of shrews, however, were significantly greater in even-aged than old-growth stands in the second period (Table 1). Age and sex ratios of mice and voles did not differ between even-aged and old-growth stands in either period. Adult:juvenile ratios (percentage adult ± SD) averaged 68 ± 33 for mice and 78 ± 24 for voles, both periods combined. Male:female ratios (percentage male) averaged 66 ± 25 for mice and 41±36 for voles, both periods combined.

Body weights of juvenile mice were significantly greater in even-aged than old-growth stands in the second trapping period (25.3 ± 1.1 vs. 20.5 ± 1.1 g). No other differences occurred between forest types. Body weights of adult mice and voles were significantly greater than those of juveniles during both periods but did not differ between periods. Mouse body weights (grams) averaged 34.9 ± 2.1 for adults and 23.0 ± 3.5 for juveniles, both periods combined. Vole body weights averaged 48.3 ± 10.2 for adults and 27.7 ± 6.9 for juveniles, both periods combined.

Vegetation within the even-aged stands was highly heterogeneous and clumped with distinct patches of

dense spruce and hemlock in areas of undisturbed soils and patches of Red Alder along old skid roads and other areas of much soil disturbance. Other areas were mixed. The heteogeneity was scattered throughout the stands. Overall, trapping stations fell into the following distributions (percentage alder:mixed: conifer): 23:47:30 for the first trapping period; and 14:33:53 for the second period. (Note: expected capture frequencies differed from those distributions slightly, depending on the distribution of snapped traps and species.) Chi-square analysis indicated that voles were more commonly associated with alder than conifer patches during the second period (20:11:12 captures observed vs. 6.4:15.3:21.3 expected). No significant differences in within-stand associations occurred for other species or trapping period.

Ranking of stands by estimated total vascular understory biomass differed slightly between the two trapping periods. Two of the three old-growth stands, however, were consistently ranked the first and second highest, and the third old-growth stand was consistently ranked the lowest (number 6 of 6). Even-aged stands were intermediate. Mice densities (Table 1) were significantly correlated with estimated total understory biomass across all stands in both trapping periods ($r_S = 0.83$ in both, $P < 0.05$, one-tailed). Vole and shrew densities were not correlated with understory biomass in either period ($r_S = -0.07$ and 0.54 for voles, periods 1 and 2, respectively; $r_S = 0.03$ and 0.07 for shrews, periods 1 and 2, respectively).

These results indicate that even-aged, Red Alder - conifer stands may be valuable small mammal habitat in southeastern Alaska and that Red Alder may be an especially important component in young stands. Van Horne (1983) showed that animal density, alone, may be a misleading indicator of habitat quality because it fails to distinguish between habitats that are capable of producing and maintaining high populations versus those that simply accumulate dispersing subordinate individuals. My data, however, are robust in that sense, because they indicate few or no differences in age, sex, and body weights, in addition to densities. Where differences did occur, they indicated more favorable habitat in the even-aged stands than in the old-growth stands. My overall conclusion of little or no difference, therefore, is conservative. The greatest weakness of my study is that it was conducted in only one year. Nevertheless, the data from the even-aged, alder-conifer stands are surprising in comparison with what might have been expected for similar-aged pure conifer stands. Red Alder stands have also been reported as productive small mammal and amphibian habitat in Oregon (McComb et al. 1993), although habitats there are quite different from those in Alaska.

Understory was abundant under Red Alder in the even-aged stands; it was extremely depauperate in the pure conifer clumps. Red Alder, itself, therefore appears to be an important factor contributing to the habitat quality of such stands. It also is important to note, however, that except for voles in the second trapping period, small mammals were distributed throughout the even-aged stands regardless of overstory type. That was true even for mice, which were correlated with understory biomass across stands in both trapping periods. The highly heterogeneous distribution of Red Alder and understory in relation to the home range size of individual animals was likely very important.

The Red Alder understory was dominated by Devils-club (*Oplopanax horridus*), Salmonberry (*Rubus spectabilis*), Elderberry (*Sambucus racemosa*), and forbs more characteristic of riparian than upland sites (e.g., Hanley and Hoel 1996). What little understory that occurred in the conifer patches, on the other hand, was mostly blueberry (*Vaccinium ovalifolium* and *V. alaskensis*), Fool's Huckleberry (*Menziesia ferruginea*), and forbs more characteristic

TABLE 1. Mean densities (number per 300 trap-nights, ± standard deviation) of the Sitka Mouse, Long-tailed Vole, and Common Shrew in even-aged, Red Alder - conifer stands and nearby old-growth stands in two trapping periods.

| | 27 May – 5 June | | 28 July – 5 August | |
|---|---|---|---|---|
| Species/age/sex | Even-aged | Old-growth | Even-aged | Old-growth |
| Sitka Mouse | | | | |
| Adults | | | | |
| Males | 6.7±3.1 | 9.9±9.0 | 11.0±3.6 | 9.0±5.2 |
| Females | 4.0±4.2 | 3.9±4.1 | 4.5±4.3 | 10.9±7.9 |
| Juveniles | | | | |
| Males | 3.1±5.4 | 0.7±1.2 | 7.3±2.1 | 6.2±7.7 |
| Females | 2.5±4.3 | 0±0 | 4.5±4.3 | 8.4±7.6 |
| Total | 16.3±10.0 | 14.5±11.9 | 28.3±6.5 | 34.9±27.6 |
| Long-tailed Vole[a] | 6.5±4.5 | 1.1±1.1 | 22.6±19.4 | 10.6±6.2 |
| Common Shrew[a] | 1.8±2.1 | 0±0 | 21.6±5.3[b] | 3.4±2.1[b] |

[a]Sample sizes for voles and shrews not sufficient for breakdown by sex and age.
[b]Mean density of shrews differed significantly (P<0.05) between even-aged and old-growth stands in 28 July – 5 August.

of upland forests (e.g., Hanley and Hoel 1996). The mixture provided a rich species diversity.

My conclusions should be viewed as preliminary because data for Red Alder understories in Alaska are so few, and data for small mammals are even fewer. This study, however, does indicate the need for more research into the potential role of Red Alder in even-aged forest management in southeastern Alaska. Clearcut logging that favors Red Alder might have significantly better consequences for some small mammal species than does high-lead clearcut logging that discourages alder.

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# Longevity of Wild White-tailed Deer, *Odocoileus virginianus*, Does in Michigan

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In conjunction with a telemetry study of White-tailed Deer in northern Michigan, we aged 110 wild adult deer (96 does, 14 bucks) by means of cementum annuli analysis of the incisorform canine tooth. Aging and subsequent radio-tracking suggested that does in this population may live unusually long (>10 years, n = 34). One doe died at 19 years, 10 months - a near record for wild deer.

Key Words: White-tailed Deer, *Odocoileus virginianus*, aging, longevity, Michigan.

Most examples of extreme longevity in White-tailed Deer are for captive or supplementally-fed individuals (Ozoga 1969). For example, Popov (1950) and Palmer (1951) reported on tame does that lived to 15 to 19.5 years. Verme (1962) reported a supplementally-fed doe that died at 12 years. Severinghaus (1949) reported that the upper limit for wild deer was 14–16 years based on the life-spans of captive deer. He speculated that the tooth wear may begin to limit deer after 10 years. Jenkins and Bartlett (1959) reported that few wild deer live past 10.5 years although they report a semi-tame doe that lived 17 years. Hoskinson and Mech (1976) aged two does at 12.9 and 13.8 years and reported that deer of that age were rare in any population. Nelson and Mech (1990) reported on 34 wild deer with ages ≥ 10 years including a 17 year-old buck and a 19 year-old doe. The oldest wild deer reported is a 20 year-old doe that was killed in New York (Sauer 1984).

Minimum ages of wild deer have been reported from trap-tag and release studies where deer were initially aged as fawns, yearlings, or adults on the basis of tooth wear and replacement (Severinghaus 1949) and recovered later. Ozoga (1969) reported on the minimum ages for wild deer in northern Michigan based on the subsequent recovery of live-trapped, ear-tagged deer. He reported 11 does whose minimum age was > 10 years. The oldest was 14 years, 9 months. Similarly, Nixon et al. (1991) reported on the minimum ages of previously-tagged Illinois does. The average age for their sample (N=42) was 6.6 years and the maximum was 10 years, 7 months.

An alternate method of aging wild deer involves analysis of the annual growth patterns in the cementum of deer teeth (Low and Cowan 1963; Gilbert 1966). Age determination based on cementum annuli analysis has shown nearly universal agreement with the known ages of captive (Low and Cowan 1963; Gilbert 1966; Erikson and Seliger 1969; Lockard 1972) and wild (Thomas and Bandy 1973) *Odocoileus* spp.; although, as noted by Roseberry (1980), only Thomas and Bandy (1973) reported using a "blind" comparison to eliminate potential bias. Occasionally, "split", "compound", or "false" annulations may confound attempts at aging deer, but this problem can be overcome by trained observers with the experience to recognize non-typical patterns (Gilbert 1966; Lockard 1972; Thomas and Bandy 1973; Rice 1980).

## Methods

As part of a telemetry study of deer migration in the Upper Peninsula of Michigan (Van Deelen 1995), we live-trapped deer during the winters of 1991–1992, 1992–1993, and 1993–1994. All deer were manually restrained and initially aged as fawns, yearlings, or adults by means of tooth wear and replacement (Severinghaus 1949). Beginning mid-way through the 1991–1992 field season, we collected canine teeth from the adult deer and submitted them to Matson's Laboratory (Milltown, Montana) for age determination via cementum annuli analysis. Matson's is a commercial laboratory that specializes in aging mammals with this technique and has had extensive experience aging White-tailed Deer (N > 10 000). Between 1975 and 1995 Matson's has aged 62 White-tailed Deer with known ages. Fifty-five (89%) of these were aged correctly, 4 (6%) were off by 1 year, and 3 (5%) were off by >1 year (Matson and Matson 1995).

We choose to use the canine teeth instead of the more commonly-used first incisors for two reasons: (1) Matson's has an aging model for use with White-

TABLE 1. Estimated ages of deer from Michigan's Upper Peninsula, 1991-1994. Unless indicated, all age estimation were assigned an "A" certainty code (Table 2).

| | Age class (years)[a] | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Sex | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| Female | 9[b] | 10 | 3 | 3[b] | 13[b] | 6[b] | 6[c] | 6 | 6 | 6 | 8 | 9[b] | 2 | 3 | 2 | 2 | | 2 |
| Male | 9 | 5[b] | | | | | | | | | | | | | | | | |

[a] Age at last birthday based on cementum annuli analysis of the lower canine tooth and an assumed birth date of 1 June.
[b]Includes 1 individual with a "B" certainty code (Table 2).
[c]Includes 2 individuals with a "B" certainty code (Table 2).

tailed Deer canines, and (2) the incisorform canine teeth are the smallest teeth in the lower jaw and are located immediately anterior to the diastema. We reasoned that removal of a canine tooth would be less traumatic for a deer than removal of a first incisor. Matson's aging model assumes a 1 June birth date.

Independently of their age, a sub-sample of adult deer (n = 24 does, 2 bucks) were radio-collared for a migration and mortality study.

## Results

We trapped 386 individual deer, 200 of which were classified as fawns (86 female: 114 male), 29 as yearlings (12 female : 17 male), and 157 as adults (146 female : 11 male). We submitted 110 canine teeth to be aged, 96 from does and 14 from bucks. We have no reason to believe that the sub-sample of deer aged though cementum annuli analysis was biased relative to the trapped sample.

The sub-sample of deer aged by means of cementum annuli analysis contained some remarkably old does (Table 1), including 34 (35%) that were ≥10 years. Matson's uses a three-tiered "certainty code" to classify each age estimate as A = results nearly certain, B = some error possible, or C = error likely (Table 2). These rankings represent a subjective judgement based on the histological characteristics of the tooth and the banding pattern in the cementum. Ninety-three percent (N = 102) of the teeth in the sample we submitted received the "A" rating, the remaining 7% (N = 8) received the "B" rating (Table 1). G. Matson (personal communication) noted that the histological condition of the teeth in our sample was excellent and the banding patterns in the cementum were unusually distinct as is the case with deer from northern Minnesota and northern Michigan.

Six of the old (>10 years, "A" certainty unless indicated) does were radio-collared and monitored between January 1992 and January 1995. One, trapped as an 11-year-old, was shot illegally when 12 years, 6 months. We lost radio contact with two does that were trapped as 12-year-olds. Ages at the time of disappearance were 13 years, 10 months ("B" certainty); and 14 years, 2 months. A doe captured as a 13-year-old was killed by Wolves (*Canis lupus*) the following spring (age = 13 years, 10 months). A doe captured as a 14-year-old was still alive at the end of the study (age = 16 years, 9 months). Finally, a doe that was captured as an 18-year-old died of undetermined causes at 19 years, 10 months. With the exception of Sauer (1984), we are unaware of wild White-tailed Deer living longer than this last individual and believe that it is among the oldest recorded.

## Discussion

We believe that recent mild winters, "buck-only" hunting regulations, and relatively low predation have combined to allow does in this population to reach such unusually old ages. Severe winter weather is a key determinant in the survival of northern deer (Verme 1968). Northern deer seek areas with protective conifer overstories, known as deer yards (Verme 1965). Starvation occurs when summer-deposited fat reserves are depleted prior to the end of the yarding season (Mautz 1978). Ozoga (1969) reported that over-winter survival was more critical than escape from hunting in allowing longevity in northern Michigan does.

TABLE 2. Certainty codes used by Matson's Laboratory (Milltown, Montana) to express confidence in age estimates based on cementum annuli analysis of White-tailed Deer teeth (G. Matson, personal communication).

| | Certainty Code | | |
|---|---|---|---|
| Estimated Age (years) | A | B | C |
| 1 - 7 | ± 0 year(s) | ± 1 | ± 2 |
| 8 - 15 | ± 1 | ± 2 | ± 3 |
| ≥16 | ± 2 | ± 3 | ± 4 |

Verme (1968) combined measurements of air chill and snow hazard in a winter severity index (WSI) that described the effects of winter weather on the region's deer. Cumulative WSIs in excess of 100 during a 20-week winter period were judged to be severe in terms of deer survival. In the 20-year period prior to this study (1973/1974 - 1993/1994), WSIs in the central Upper Peninsula averaged 84.2 (SD = 27.2). In the 10-year period prior to this study (1983/1984 - 1993/1994), WSIs averaged 67.6 (SD = 19.4; Michigan Department of Natural Resources, unpublished data). During the three years of this study (January 1992 - January 1995), there was no starvation-related mortality among radio-collared adult does (N = 56 deer-years; Van Deelen 1995).

Hunting mortality is a major source of mortality for exploited deer populations (Dusek et al. 1989; Fuller 1990). In this part of northern Michigan, hunting mortality is strongly biased towards adult males because deer must have antlers that are 3 inches or longer (7.6 cm) to be legally shot during the firearm deer season, a tradition in Michigan dating to 1921 (Langenau 1994). Bucks-only hunting regulations usually results in residual populations that contain high densities of primarily older does (McCullough 1984). Van Deelen (1995) reported that annual hunting mortality was 73% for adult bucks but only 5% for adult does. Among yearlings, hunting mortality was 42% and 11% for bucks and does respectively.

Predation was a minor source of mortality (5% for does in this population [Van Deelen 1995]). Bobcats (*Lynx rufus*) and Coyotes (*Canis latrans*) are the principle predators of deer in northern Michigan (Ozoga 1972). Black Bear (*Ursus americanus*) predation is unimportant except for neonates (Ozoga and Verme 1982). Wolves were present in the Upper Peninsula of Michigan but populations were in the early stages of recovery and numbers were low (n = 80 in 1995; J. Hammill, personal communication). During the 1970s and 1980s Wolves were effectively extirpated (Baker 1983).

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# Denning Patterns of Porcupines, *Erethizon dorsatum*

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We investigated the winter denning patterns of Porcupines (*Erethizon dorsatum*) in Massachusetts during two winters (1991–1992 and 1992–1993) in two study areas that differed in both availability of den sites and types of dens to assess whether frequency of den sharing was related to den density, den distribution, weather, or mating season. In the Central area, where there were fewer available den sites and fewer dens used per individual, Porcupines which denned together did so relatively often (64-78% of locations in dens). However, in the East area, where den site availability was higher, Porcupines denned together less frequently (9-37%). Fewer Porcupines denned with another Porcupine at least once in the Central area (45 vs. 70%), but dens were more dispersed there and five porcupines rested in trees and never used a den in winter. In addition, more severe winter weather reduced sharing. Male-female pairing was not limited to mating season and mating activity did not help to explain late winter den sharing.

Key Words: Porcupine, *Erethizon dorsatum*, den, Massachusetts.

Den sharing (two or more Porcupines occupying the same den simultaneously) by Porcupines has been documented (e.g., Dodge 1967: 20; Kelly 1973; Wolfe 1990), but most studies have found only occasional den sharing (Curtis and Kozicky 1944; Dodge and Barnes 1975; Speer and Dilworth 1978; Tenneson and Oring 1985; Roze 1987). Suggested causes of den sharing are low den site availability (Roze 1987), inclement weather (Wolfe 1990), and mating (Dodge and Barnes 1975). We investigated the denning patterns of radio-marked Porcupines over two winters (1991–1993) in two study areas that differed in relative availability of dens and types of dens to test the hypotheses that den sharing was related to low den density, severe weather, or mating.

## Study Area

We studied Porcupines in two areas on the Prescott Peninsula of the Quabbin Reservation in central Massachusetts during winters (November-April) 1991–1992 and 1992–1993. The areas occurred within the Hardwoods-White Pine (*Pinus strobus*)-Hemlock (*Tsuga canadensis*) transition zone (Westveld et al. 1956). Study sites were 89% forested and 11% open meadow or water, and between 162 to 351 m elevation. Portions of the East area (2.2 $km^2$) contained a talus slope ranging from 100-300 m wide below a 3-5 m high headwall that extended N-S for 3 km. Available den sites consisted of cavities among the rocks all along the east facing talus slope. There also were hollow trees and large hollow logs in the area. The Central area (3.1 $km^2$) did not contain large rock outcrops. Available den sites consisted of hollow trees, large hollow logs, and crevices in stone walls. Fisher (*Martes pennanti*), Coyote (*Canis latrans*), and Bobcat (*Felis rufus*), known predators of Porcupines, were present in the study areas.

## Methods

During the two winters of study, 43 radio-collared individuals were monitored as part of a larger study of Porcupine population dynamics and habitat use (Griesemer 1995; Hale and Fuller 1996). Porcupines were captured, sexed, aged, marked, and radio-collared during the five months (June-October) before the den season started, and then relocated 1-7 times per week. For each location, marked cohabitants were identified by radio signals or observation of ear tags.

We estimated den availability in each area by locating radio-marked Porcupines in dens, by finding dens with unmarked Porcupines in them or with droppings at the entrances either during random searches or fortuitously in each area. We recognize that all dens used by Porcupines likely were not found; however, the number of porcupines monitored and the amount of search effort were similar in each area, thus our estimates are reasonable to use for comparisons between areas. Each den was marked with a numbered aluminum tag in order to monitor repeated use. Porcupines were considered to be sharing the same den only if they were observed in the same passageway or hollow. Large rock caverns were considered to have separate dens when they had multiple passageways that did not connect. Den sharing was calculated as the proportion of all

locations in dens of individual Porcupines that were with one or more other marked or unmarked Porcupines at the same time.

During November-April, the period that our Porcupines used dens, we rated daily weather severity using a winter harshness index (WHI) based on snow thickness and temperature (Griesemer 1995). This index was calculated by subtracting daily mean temperature (°C) for a given day from snow thickness (cm) for that day (e.g., for a day with a mean snow thickness of 10 cm and a mean temperature of -5, WHI = 15). From the distribution of these indexes, days rated below 18 reflected "mild" winter weather and those days rated above 18 "harsh" weather. The second winter was rated more harsh ($\bar{X}$ daily index = 16.8) than the first winter ($\bar{X}$ = 4.3) due to both lower temperatures and thicker snow cover.

## Results

By following the same number of radio-marked Porcupines in each area, and searching randomly with the same effort in each area, we found twice the dens in the East ($n$=68) versus the Central area ($n$=36). Thus the minimum density in use was 26 dens/km$^2$ in the East area versus 12 dens/km$^2$ in the Central area, even though Porcupine density in both areas was similar (12-16 individuals/km$^2$; Hale and Fuller 1996).

Dens in the East area consisted of one tree den, 61 rock dens, two logs, two root dens, and two crevices in stone walls. The rock dens in the East area were close together, all within one long talus slope. The Central area contained 17 dens in large trees or snags, 10 rock dens, five log dens, one den in tree roots, one crevice in a stone wall, one bank burrow, and one road culvert. These dens were widely spaced and thus not concentrated as in the East area.

Of the 43 marked Porcupines monitored (13 Central and 15 East during the first winter; 14 Central and 11 East during the second), 32 used dens, five used tree limbs for resting and did not use dens (all in the Central area), two rested in dens and trees without dens about equally, and four had too few locations (< 5) to determine a pattern. Overall, the number of dens used by an individual Porcupine both winters averaged 3.4 in the East area and 1.9 in the Central area (Table 1). As many as eight dens per winter were used by some individuals. All five Porcupines monitored during both winters in the Central area, and five of seven in the East area, used one to all of the same dens in both years. During the second winter, which was more severe, fewer dens were used per individual in the East area than in the first winter.

In the East area, where dens were numerous and close together, 16 of 23 (70%) of marked Porcupines shared dens at least once. However, only nine of 20 (45%) of Porcupines in the Central area shared dens at least once ($\chi^2$ = 2.85, 1df, $P$ < 0.103), in part because at least five individuals there rested on tree limbs and never used dens during winter, and because others used isolated dens.

The proportion of den or resting site relocations during which dens were shared by female Porcupines ranged from 8% in the second winter in the East area to 89% in the first winter in the Central area (Table 2). Percent of locations with den sharing was significantly less in the second winter with harsher weather versus the first winter for Central area females ($P$ < 0.001), East area females ($P$ < 0.006), and East area males ($P$ < 0.001). Only two of seven males in the Central area used dens in both winters; no difference was detected between their proportions of locations with den sharing.

Differences in male-female den sharing between mating (October-November; Roze 1989: 155) and non-mating season were not significantly different in either area ($P$ < 0.001) (Table 3). Various combinations of numbers and sexes of porcupines shared dens throughout the winter. One pair of males was found denning together in the same den both winters. In addition, one juvenile (< 1 year old) male was found denning 10 times with an adult male and twice with an adult female in the East area. On one occasion, all three were found together in one den in January.

TABLE 1. Number of Porcupines and the mean and range of number of dens used by individual radio-marked Porcupines during winters 1991–1992 and 1992–1993 on two study sites, in west-central Massachusetts.

| | | 1991–1992 | | | 1992–1993 (harsher winter) | | |
|---|---|---|---|---|---|---|---|
| Area | Sex | $\bar{x}$ | range | n[a] | $\bar{x}$ | range | n[a] |
| Central | Females | 1.6 | (1-3) | 8 | 2.2 | (0.3) | 11 |
| | Males | 2.4 | (1-4) | 5 | 1.3 | (1-2) | 3 |
| | Total | 1.9[b] | (1-4) | 13 | 2.0 | (0-3) | 14 |
| East | Females | 3.6 | (1-8) | 8 | 2.9 | (1-4) | 6 |
| | Males | 4.6 | (2-7) | 7 | 2.8 | (0-8) | 5 |
| | Total | 4.0[b] | (1-8) | 15 | 2.8 | (0-8) | 11 |

[a] n = the number of different Porcupines monitored in each winter.
[b] The number of dens used by all Porcupines differed ($t$ = -2.98, df = 26, $P$ < 0.006) between areas in the first year.

TABLE 2. Percent of Porcupine locations in dens in which den sharing occurred during winters 1991-1992 and 1992-1993 on two study sites, in Massachusetts.

| | | 1991–1992 | | | 1992–1993 (harsher winter) | | |
|---|---|---|---|---|---|---|---|
| Area | Sex | % | n locations | n Porcupines | % | n locations | n Porcupines |
| Central | Females[ab] | 89 | 132 | 8 | 66 | 100 | 11 |
| | Males[c] | 17 | 23 | 5 | 20 | 5 | 3 |
| | Total[d] | 78 | 155 | 13 | 64 | 105 | 14 |
| East | Females[ab] | 32 | 114 | 8 | 8 | 36 | 6 |
| | Males[ac] | 43 | 108 | 7 | 10 | 30 | 5 |
| | Total[d] | 37 | 222 | 15 | 9 | 66 | 11 |

[a]Percent den sharing differed between years for Central area females ($\chi^2 = 16.59$, df = 1, $P < 0.001$), East area females ($\chi^2 = 7.68$, df = 1, $P < 0.006$) and East area males ($\chi^2 = 10.89$, df = 1, $P < 0.001$).
[b]Den sharing by females differed ($\chi^2 = 105.9$, df = 1, $P < 0.001$) between areas in both years.
[c]Den sharing by males differed ($\chi^2 = 5.1$, df = 1, $P = 0.024$) between areas in the first year.
[d]Den sharing differed ($\chi^2 = 96.37$, df = 1, $P < 0.001$) between areas for all Porcupines in both years.

Some pairings of Porcupines remained consistent throughout the winter while others changed. Four individuals, all females, used one den regularly the first winter in the Central area (Table 3). Three returned the second winter (the fourth had died) and used the den regularly. The den was also used regularly by another female in the second winter at the same time as the original three were in it and occasionally by one other female and two males. On one occasion, one other den in the Central area contained two Porcupines, one female and one unmarked. No other den sharing was documented in this area. One den was used by three different Porcupines, but not at the same time.

## Discussion

Roze (1987) suggested that lower den density causes Porcupines to share dens, and our data support this notion to some extent. Limited den availability increased den sharing for individuals in the Central area, but den sharing was also common in the East area where Porcupines (at about the same density) had twice as many dens available. The talus slope was the major distinguishing feature of the East area. This provided a greater number of available dens within close proximity to each other, and more opportunity for Porcupine movement between dens. This suggests that sharing also may serve a predator avoidance, social, or thermal function as yet unidentified. While the influence of predator avoidance on choice of resting sites by Porcupines has been noted (Sweitzer and Berger 1992; Stricklan 1995), we did not evaluate the possible relation of this to den sharing because none of the 14 deaths of radio-marked Porcupines in our study area were due to predation (Hale and Fuller 1996).

In Vermont, Wolfe (1990) found a large number of porcupines denning together during severe weather and suggested this may be a factor affecting den sharing. In our study, the second winter was much

TABLE 3. Combinations of male and female Porcupine den sharing occurrences and the months in which they occurred during winters 1991-1992 and 1992-1993 on two study sites, in west-central Massachusetts.

| Area | Sexes[ab] | Mating Season | Non-mating season |
|---|---|---|---|
| Central (9)[c] | FF | Oct | Dec, Jan, Feb, Mar, Apr |
| | FFF | Oct, Nov | Jan, Feb, Mar, May |
| | FFFF | Oct, Nov | Dec, Jan, Feb, Mar |
| | FFFM | Oct | Jan |
| | FFFFM | | Jan |
| East (16)[c] | FF | | Jan, Feb, Mar |
| | FFF | Nov | |
| | FM | | Feb, Mar |
| | FFM | Nov | |
| | FMM | | Dec, Jan, Feb |
| | MM | | Dec, Jan, Feb, Mar |

[a]Differences in heterosexual sharing between mating and non-mating season were not significantly different at $P < 0.001$.
[b]The number of Porcupines sharing within one den differed ($t = 7.2$, df = 115, $P < 0.001$) between areas.
[c]Total marked Porcupines sharing dens.

more severe than the first due to both colder temperatures and thicker snow, and there was less, not more, shared denning in the East area during that winter. Severe weather may have limited Porcupine movements between dens and consequently decreased incidence of den sharing.

Male-female pairing was not limited to mating season (cf Dodge and Barnes 1975). Males and females shared dens as late as March, and many same-sex combinations were found. While mating may be a factor in den sharing during October-November, it does not fully explain the den sharing behavior.

In the area with lower den density, a greater proportion of locations were shared. Den density may affect den sharing, but it probably is not the single causal factor. Contrary to expectations, we found a more severe winter correlated with less den sharing, possibly due to limited movements. Mating was not shown to be a major factor as male-female den sharing occurred throughout the winter and was not limited to the mating season.

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# Status of the Harlequin Duck, *Histrionicus histrionicus*, in the Western Northwest Territories

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Details of historic and recent observations of the Harlequin Duck, *Histrionicus histrionicus*, in the western Northwest Territories including several possible breeding records are summarized. This evidence suggests a widely distributed population in the western Northwest Territories numbering in the hundreds of breeding pairs.

Key Words: Harlequin Duck, *Histrionicus histrionicus*, Northwest Territories, distribution, breeding.

The Harlequin Duck, *Histrionicus histrionicus*, has received attention in recent years because of declines in eastern North America. However, indications of declines in western North America also provide reason for concern (Breault and Savard 1991; Goudie et al. 1994). Effective conservation of this species may be constrained by a lack of information on basic biology and distribution (Breault and Savard 1991).

Descriptions of the western distribution of the Harlequin Duck in modern ornithological literature invariably fail to recognize adequately the status of this species in the western Northwest Territories (NWT) (e.g., Palmer 1976; Bellrose 1980). A few references record it as a casual or accidental visitor to the region (e.g., A.O.U. 1983; Godfrey 1986).

In the following account we provide details of observations of Harlequin Ducks in the western NWT from historic and recent published and unpublished sources. Our objective is to promote awareness of the western NWT breeding population of the Harlequin Duck, so that it may be adequately recognized in future discussions and actions regarding the conservation of this species.

## Historical Records

The first written account of the Harlequin Duck in the NWT was that of Richardson (1851) who observed small flocks in the vicinity of Great Bear River and took specimens there. Ross (1862) was the first author to assess the status of this species in the NWT, stating that it occurred north to the Arctic coast but was rare throughout the region. Baird et al. (1884) reported several specimens which were collected; near Fort Resolution, at Fort Simpson, at Fort Rae, and on the Barren Lands. Russell (1898) took a female specimen near Fort Rae 27 July 1893 (Preble [1908] also referred to this specimen, stating that it was probably collected in the vicinity of the Yellowknife River).

Preble (1908) reported: "Adult males, ..., said to have been shot near the post, were obtained ... at Fort Resolution in 1901 and 1903. ... in 1903 I took a specimen among the rapids on the river north of Lake Hardisty on August 20, and noted another on the lower part of the same stream August 24. ... In the spring of 1904 a pair was secured from a flock of four near Fort Simpson, May 25. ... This duck is said to be often seen on Bluefish Creek, a small rapid stream emptying into the Mackenzie opposite Fort Simpson. ... the bird catalogue of the National Museum shows that skins were received also from Peel River and Fort Liard." Anderson (1913) noted: "Mr. H.W. Jones reported the first arrival at Hay River, May 16th, 1908." Harper (1914)* obtained a specimen: "... said to have been shot in the spring of 1912 on one of the channels of the Slave River delta." Soper (1942, 1957) observed this species only once: "... a full-plumaged male encountered on July 8, 1932, a few miles up Buffalo River south of Great Slave Lake."

## Recent Records

Grunberg (1979) reported a pair at Tartan Rapids on the Yellowknife River 13 May, and a pair at Mosquito Creek near Rae-Edzo 24 May 1979. Salter (1974) observed four (sex ratio not given) at Fort Providence during fall migration between 9 September and 1 October 1972. Salter et al. (1974) observed eight Harlequin Ducks at Fort Simpson (one male and a pair 17 May; one female and a pair 18 May; and a pair 22 May); two at Norman Wells (a pair 23 May); and two at Wrigley (a pair 17 May) in 1973 (these may include duplicate sightings).

Bromley and Trauger (1981) listed the Harlequin Duck as rare in the Yellowknife area. This status was

*See Documents Cited section.

based upon five observations between 1965 and 1979. Two of these observations were published by Grunberg (1979) and noted earlier. The remaining three included an observation on Great Slave Lake 25 May 1965 (sex and number of birds unknown); a pair observed on a roadside pond near Yellowknife 21 May 1965; and two males accompanying a female on the Yellowknife River at Fishing Lake in June 1977. Sirois (1989) reported two Harlequin Ducks on the lower Beaulieu River 26 May 1988, one pair plus one male on the lower Yellowknife River over the period 7-17 May 1988, and a pair plus one male on the Mackenzie River at Fort Providence 23 May 1988. Another pair was observed on the lower Yellowknife River 24 and 26 May 1990 (J. Sirois personal communication to MAF, RGB personal observation). A single bird was observed on the upper Keele River July 1990 (P. Latour personal communication to RGB). A pair was observed on the Johnny Hoe River 3 July 1992, and another pair on Canyon Creek in May 1992 (or 1993?) (P. Rivard personal communication to RGB).

### Breeding Records

Phillips (1926) reported a possible early breeding record of the Harlequin Duck for the western NWT: "... Raine (1892) says he has eggs sent him by missionaries from the mouth of the Mackenzie(!) ...". However, he does not appear to attach much credibility to this record as in the preceding sentence he remarks: "There is no very good evidence that the Harlequin nests anywhere in the Mackenzie and Athabasca basins." MacFarlane (1908) provided more details of this record, including the most comprehensive description of a possible nesting site of the Harlequin Duck in NWT. He states: "... Mr. Raine, of Toronto, writes that it does breed at the Mouth of the Mackenzie River, where one of his collectors found and sent him eight eggs with the skin of the parent bird. The nest was found on the 19th of June, 1894. It was on a high bank, near some ice floes, under sticks piled up by overflow water in the spring."

Phillips' scepticism may have been warranted. Peck and Richards (1994) reported that Raine was guilty of errors in identification; the honesty and credibility of his dealings were sometimes suspect; and some professional ornithologists refused to accept any of his records. However, after studying Raines' Saskatchewan records, Houston (1981) concluded that many could be accepted with reasonable confidence. In light of Houston's review, the great detail of this record provided by MacFarlane, and recent breeding records for this species listed below, we believe it highly probable that this record is valid.

Preble (1908) and Phillips (1926) provided details of a second possible early breeding record in their accounts of the Harlequin Duck in NWT. Preble stated: "Reed records eggs from Peel River, taken June 13, 1898, ...". However, Reed's (1904) own account reported this location as: "Peel River, Alaska, ... Seven eggs in a hollow in river bank, lined with down." Although not explicitly stated by either Preble (1908) or Phillips (1926), it appears that these authors perceived an error in Reed's account and corrected it in their own later monographs. There is a Peel River in the Mackenzie River drainage, NWT, but we could find no reference to a Peel River in Alaska (Times Books 1992; NISC 1995*). This appears to be a valid breeding record for NWT.

The Harlequin Duck is recognized as a regular breeder in the vicinity of Oldsquaw Lodge (63°30′N 129°00′W) in the Mackenzie Mountains. Miller et al. (*in preparation**) state: " Nesting pairs are commonly seen near fast water near the Lodge, at Caribou Pass, and along the Tischu and Intga Rivers. Young were seen in the area as late as 27 August in 1982." The present owners of the lodge report seeing two to three broods of three to five young each year, and male groups of up to six per flock (N. Barichello personal communication to RGB and MAF). Further verification of breeding in the Mackenzie Mountains is provided by the observation of a brood in the Mountain River area in July 1992 (P. Latour personal communication to RGB) and a brood at Carcajou Lake 7 August 1992 (R. Popko personal communication to RGB).

Bromley and Trauger (1981) listed this species as breeding in the Yellowknife area. Although specific details are lacking, this assessment was based on the word of a respected and knowledgeable naturalist, W. L. MacDonald, who resided in the Yellowknife area for many years and travelled extensively in NWT from 1922 to 1970. A synopsis of his knowledge of the species stated: "Noted breeding in the Taltson River area from the Alberta border to Slave Lake; on the Cameron River 40 mi. NE of Yellowknife; on the Yellowknife River, formerly in the series of rapids at Con Hydro, lately in rapids just above Quyta Lake; in the series of rapids below the Snare River Hydro; on the Camsell River at White Eagle Falls; on the Bear River Rapids; and on the Carcajou River, 30 miles west of Norman Wells" (unpublished notes in the possession of RGB).

## Discussion

These observations indicate a widespread distribution of the Harlequin Duck in the western NWT. More importantly, they establish the existence of a breeding population in the region, a fact poorly recognized. The Harlequin Duck breeds most often in the vicinity of turbulent streams and rivers where water quality and insect abundance are high, and human activities are limited (Palmer 1976; Bellrose 1980; Breault and Savard 1991). Such habitat exists throughout the Mackenzie Mountains, within the Tundra Cordillera Ecozone, an area of about 152 394 km$^2$ (Wiken

1986). This area probably comprises the core of the distribution in western NWT. However, there is evidence that the fast flowing rivers along the edge of the Precambrian Shield (e.g., Cameron; Snare; Taltson; Yellowknife) may also support modest numbers. These observations do not provide us with enough data to estimate precisely the size of the breeding population in the western NWT. However, extrapolation of even the lowest breeding densities reported for the species, to the amount of potential breeding habitat available in the region, suggests a population numbering in the hundreds of breeding pairs.

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# Distance Sampling to Estimate Fledgling Brood Density of Forest Birds

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Research on the status of avian communities often relies on estimates of abundance, but does not always consider demographic factors such as productivity. We introduce the application of a distance-sampling technique for estimating brood density of fledgling birds in forested habitats. During 1993 and 1994, we conducted 60 line-transect surveys on 10 sites in the Green Mountain National Forest in Vermont. Sites were divided into two groups, which allowed us to test for differences in fledgling density between groups. We detected 508 broods representing 38 species. Using standard distance-sampling procedures, we estimated densities of 0.576 (C.V. = 11.89) and 0.513 (C.V. = 12.54) broods per hectare. Density was not statistically different between groups. As with other survey methods, distance sampling favors easily detected species; however, line-transect density of fledglings is less obtrusive and less labor-intensive than mist-netting or nest searches, and can contribute important information to studies of avian communities.

Key Words: songbirds, productivity, brood density, distance sampling, line-transect survey, forests, Vermont.

Evidence supports the hypothesis that degradation of breeding habitat has caused population declines of neotropical migrant birds by diminishing reproductive success (Sherry and Holmes 1992; Robinson et al. 1995). In order to understand population declines and to implement conservation plans effectively we need to learn more about productivity and survivorship (Robinson 1992b; Martin 1992). Data on these demographic factors represent an improvement over such traditional measures as after-hatching-year density. Although many studies have focused on density (e.g., Freemark and Merriam 1986; Askins and Philbrick 1987; Blake and Karr 1987; Derleth et al. 1989; Thompson et al. 1992; Welsh and Healy 1993), this measure reflects many demographic processes, and can be misleading (Robinson 1992a; Vickery et al. 1992).

Ralph et al. (1993) emphasized the importance of field monitoring procedures that reflect avian productivity. At least two major continent-wide programs have been initiated to gather these kinds of data. Monitoring Avian Productivity and Survivorship (MAPS), a mist-netting program, and the Breeding Biology Research and monitoring Database (BBIRD), an ongoing compilation of nest monitoring data, are currently being administered (Martin and Guepel 1993; Ralph et al. 1993).

Productivity data are difficult to obtain and often cannot be collected over a large area without a cooperative effort such as MAPS. Ralph et al. (1993) detailed two methods for monitoring productivity. Using mist nets to capture birds may provide excellent demographic data, but yields only an index to productivity. The area sampled using mist nets is constrained by the ability of the crew to move rapidly from net to net while processing birds; one 5-10-ha station requires 10 person-days. Also, nets usually must be strategically arranged in choice locations in order to capture a sufficient number of birds (Ralph et al. 1993). Such arrangements, which are usually non-random, often violate statistical assumptions.

A second method, nest monitoring, provides a direct measure of productivity but can be impractical with limited resources. Finding nests is labor-intensive, and nest searching suffers even greater limitations in terms of area sampled and number of species surveyed than does mist-netting. Finding and monitoring nests also has the potential for causing nest desertion or increased predation, although these impacts often can be minimized or eliminated (Ralph et al. 1993). The utility of nest searches has been demonstrated in studies focusing on restricted areas or on a small number of species (e.g., Patnode and White 1992; Camp and Best 1994). Although our knowledge of species-specific productivity and survival needs to be enhanced, studies of avian habitat degradation need to focus on entire species assemblages (Martin 1992). Current capabilities for monitoring productivity must be augmented to meet this objective.

We used line-transect surveys to estimate productivity. We believed that recently fledged young were conspicuous enough to be detected in sufficient numbers that their density could be estimated with acceptable precision to provide a comparative measure of productivity. This study was a novel application of distance-sampling methods, because of the between-group comparison and the composite distri-

bution of distances resulting from data collected for many, rather than a single, species.

Distance sampling is a class of techniques, which includes line-transect sampling (Burnham et al. 1980) for determining density of biological populations. Estimates of density are computed using a set of distances measured from randomly placed lines to the objects of interest. Objects of interest need not be randomly distributed as long as the transects are arranged randomly. Transect sampling represents an improvement over strip transects and other classical finite population sampling techniques that assume a complete census of objects within the sampled area (i.e., all objects are detected), and calculate density as the number of detected objects divided by the area sampled. It is not necessary to know the size of the survey area if density alone is the parameter of interest. Unbiased estimates of density can be obtained even when many objects go undetected (Buckland et al. 1993).

A central concept of transect sampling is the detection function, the probability that an object is detected given that it is located some specific distance from the transect. The detection function is identical in shape to the probability density function of distances. Measured distances thus contain information about missed detections, and estimation of density becomes a process of estimating this probability density function.

In addition to sound survey design and execution, several assumptions are necessary for successful application of line-transect sampling: (1) objects on the line are detected with certainty, (2) objects are detected at their initial location, and (3) distance measurements are exact. Although violation of

TABLE 1. Number of fledgling broods detected per species on 30 line transects on the Green Mountain National Forest, Vermont, 1993 and 1994.

| Species | # broods |
|---|---|
| Ovenbird, *Seiurus aurocapillus* | 76 |
| Black-throated Blue Warbler, *Dendroica caerulescens* | 74 |
| Black-throated Green Warbler, *Dendroica virens* | 65 |
| Black-capped Chickadee, *Parus atricapillus* | 43 |
| Blackburnian Warbler, *Dendroica fusca* | 36 |
| Golden-crowned Kinglet, *Regulus satrapa* | 22 |
| Dark-eyed Junco, *Junco hyemalis* | 21 |
| American Robin, *Turdus migratorius* | 19 |
| Yellow-bellied Sapsucker, *Sphyrapicus varius* | 19 |
| Hermit Thrush, *Catharus guttatus* | 12 |
| Blue Jay, *Cyanocitta cristata* | 11 |
| Unidentified fledgling | 9 |
| Ruffed Grouse, *Bonasa umbellus* | 8 |
| White-throated Sparrow, *Zonotrichia albicollis* | 8 |
| Brown Creeper, *Certhia americana* | 7 |
| Canada Warbler, *Wilsonia canadensis* | 7 |
| Winter Wren, *Troglodytes troglodytes* | 7 |
| American Redstart, *Setophaga ruticilla* | 6 |
| Yellow-rumped Warbler, *Dendroica coronata* | 6 |
| Least Flycatcher, *Empidonax minimus* | 5 |
| Magnolia Warbler, *Dendroica magnolia* | 5 |
| Red-eyed Vireo, *Vireo olivaceus* | 5 |
| White-breasted Nuthatch, *Sitta carolinensis* | 5 |
| Hairy Woodpecker, *Picoides villosus* | 4 |
| Red-breasted Nuthatch, *Sitta canadensis* | 4 |
| Swainson's Thrush, *Catharus ustulatus* | 3 |
| Wood Thrush, *Hylocichla mustelina* | 3 |
| Chestnut-sided Warbler, *Dendroica pensylvanica* | 2 |
| Downy Woodpecker, *Picoides pubescens* | 2 |
| Rose-breasted Grosbeak, *Pheucticus ludovicianus* | 2 |
| Scarlet Tanager, *Piranga olivacea* | 2 |
| Solitary Vireo, *Vireo solitarius* | 2 |
| Veery, *Catharus fuscescens* | 2 |
| Black-and-white Warbler, *Mniotilta varia* | 1 |
| Broad-winged Hawk, *Buteo platypterus* | 1 |
| Cedar Waxwing, *Bombycilla cedrorum* | 1 |
| Common Grackle, *Quiscalus quiscula* | 1 |
| Pileated Woodpecker, *Dryocopus pileatus* | 1 |
| Tree Swallow, *Tachycineta bicolor* | 1 |

TABLE 2. Estimates of fledgling brood density (#/ha), bootstrap coefficients of variation, and model selection criteria (AIC, and chi-squared goodness-of-fit statistics) for distance data collected on 59 line-transect surveys on the Green Mountain National Forest, Vermont, 1993 and 1994.

| Sites | Density | C.V. | AIC | Total $\chi^2$ | $P^1$ |
|---|---|---|---|---|---|
| Group I | 0.576 | 11.89 | 790.12 | 2.07 | 0.73 |
| Group II | 0.513 | 12.54 | 813.07 | 0.74 | 0.95 |

[1]Probability of a greater chi-squared.

assumptions often can be avoided with proper survey design and execution, procedures also are available for addressing violation of assumptions in the analysis stage (Buckland et al.1993). We report on an application of distance-sampling to estimate brood densities of fledgling birds in a forested region of Vermont.

## Study Area and Methods

We conducted this research on the northern two-thirds of the Rochester and Middlebury Ranger Districts of the Green Mountain National Forest (GMNF). This section of the GMNF contains the central ridge of the Green Mountains and features peaks that exceed 1200 m in elevation. Mountains drop steeply to the east where the forest boundary follows the White River. National Forest land on the western side reaches farther from the central ridge and includes smaller mountains and rolling foothills that rise from the Lake Champlain valley. East Middlebury at 130 m represents the lowest elevation.

Forest covers 94% of the northern GMNF. This forest is dominated by northern hardwoods, which make up 77% of the forest area. Approximately 20% of this forested area contains mixed northern hardwoods/spruce-fir, high-elevation spruce-fir, or Paper Birch (*Betula papyrifera*) cover types. Balsam Fir (*Abies balsamea*), Eastern Hemlock (*Tsuga canadensis*), White Pine (*Pinus strobus*), Red Pine (*Pinus resinosa*), Red Oak (*Quercus rubra*), Quaking Aspen (*Populus tremuloides*), and Red Maple (*Acer rubrum*) forest types account for about 5% of the forest area.

We collected data on 500-ha circular sites stratified according to the presence or absence of forest openings. Group I sites contained openings that accounted for approximately 10% of total site area. Group II sites were at least 99% forested. We considered openings to be any 0.5-ha or greater area consisting of non-forest cover, or of forest cover < 8 years old. We surveyed four sites in 1993 and six sites in 1994. Sites encompassed elevations between 340 and 950 m and were located within the mid-slope land-type association on either side of the central ridge.

We established three transects, each approximately 3 km long, on each 500-ha site. Beginning at randomly selected starting points, transects consisted of straight line segments corresponding to grid points spaced 200 m apart. Transects sometimes contained several 90-degree turns in order to stay within boundaries, or to avoid openings and other transects. Although Buckland et al. (1993) include transect designs that incorporate such turns, we tried to use them sparingly. Transects were flagged at intervals of 25 m or less.

Observers surveyed transects during the first three weeks of July, which constitute nearly the full extent of the fledgling period for the birds of interest in the study area. Two observers each walked one transect per day until each observer had covered all transects. To prevent double-counting we usually allowed at least 10 days between transect replicates. Sampling began at 05:30 and usually ended before 11:00. We did not sample on days with substantial precipitation or wind.

Observers searched for fledglings while walking slowly along a transect, stopping occasionally, and leaving the transect as necessary for identification and measurement. The few broods encountered during these periods away from the transect were not recorded unless they were still apparent when surveying resumed. All observers were experienced in identification by sight and sound of all species in the study area, but had not received specific training or experience in the identification of fledgling birds. Fledglings were detected by sight or sound. Some detections were readily identified by sound, but others required more effort. We often made identifications based on the appearance or calls of attending adults. To minimize risk of flushing birds from their original locations, observers attempted to determine fledgling locations at the time of detection and before any further efforts to get a closer look. We measured perpendicular distance from the transect to the closest detected individual in a fledgling brood by pacing back to the transect from the location at initial detection. Early efforts to count individual fledglings were unsuccessful, so we counted broods. A hand-held compass was used to determine perpendicular direction.

We used program DISTANCE, a PC-compatible program available from Buckland et al. (1993), to perform comprehensive analyses of line-transect data. The program implements several robust models for the detection function, provides information to

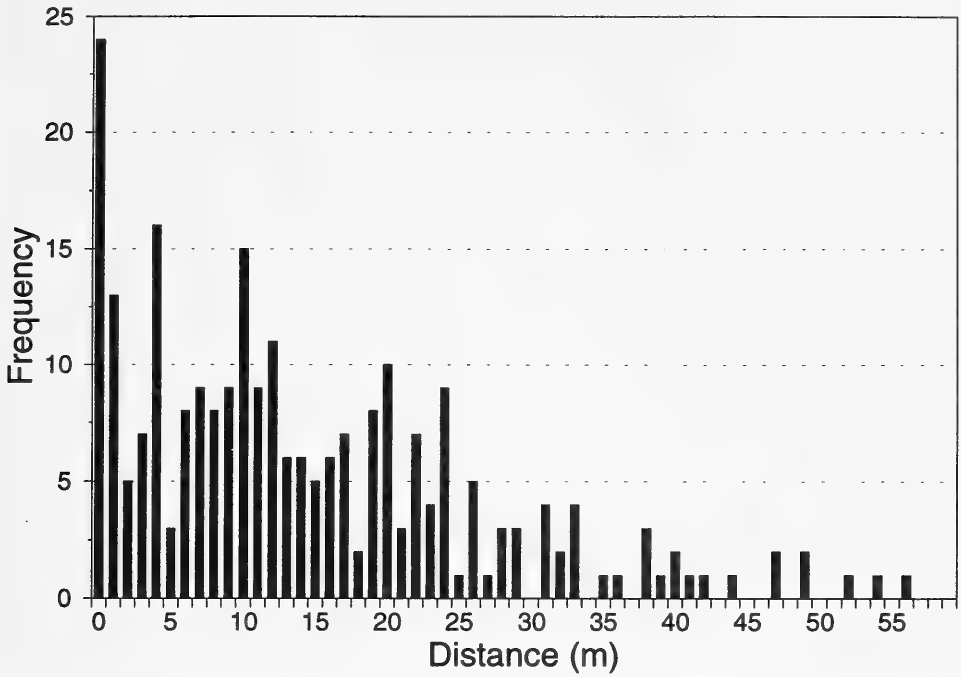


FIGURE 1. Frequency distribution of perpendicular distances measured from 29 line transects to fledgling broods on Group I sites on the Green Mountain National Forest, Vermont, 1993 and 1994. (4 values > 60 m not shown.)

assist selection of the best-fitting model, and computes density and variance estimates. Histograms of distance data were inspected for evidence of violating statistical assumptions and for appropriate cutpoints for grouping data. Grouping of distances was an effective method for improving estimator robustness when assumptions may have been violated (Buckland et al. 1993). We also truncated outliers (~5% of the distances), which were not helpful in modeling the detection function and could have led to an overparameterized model. We then used program DISTANCE to fit and select the best of four models for the detection function. Distances were partitioned into groups, with the partition points adjusted as necessary to improve model fit. Data partitioning and truncation steps used were all standard distance sampling procedures described in Buckland et al. (1993).

The "half-normal model with hermite polynomials" was selected as the best fit to the detection function for both Group I and Group II sites. Model selection was based on Akaike's Information Criterion (AIC), although chi-squared goodness-of-fit statistics were also considered. Buckland et al. (1993) preferred AIC over the chi-squared test for several reasons.

Following model selection we used DISTANCE to compute brood density and variance estimates with a bootstrap technique. This analysis procedure was conducted separately for Group I and Group II sites, to test for differences in fledgling brood density between the two groups.

## Results

We detected 508 broods representing 38 species (Table 1). This total greatly exceeded the recommended minimum sample size requirement of 60-80 detections (Buckland et al. 1993). Broods of Ovenbirds, Black-throated Blue Warblers, Black-throated Green Warblers, Black-capped Chickadees, and Blackburnian Warblers accounted for 58% of detections. Detections per species ranged from 76 Ovenbird broods to a single brood of several less-common or less-visible species. Nine broods were not identified to species and were thus categorized as "unidentified fledgling"; these instances were often solitary fledglings. Density estimates were not different between the two groups of study sites ($P > 0.10$, Table 2).

Our analysis included 59 transects representing a total length of 184 km (one survey of one transect was not included because of a problem with measured distances). Histograms of distance data were comparable between Group I and Group II sites (Figures 1, 2). Approximately 5% of the distances were truncated by specifying a maximum distance of

42 m during analysis. Detections were high at zero distance, but decreased in a jagged pattern with increasing distance. A particularly large spike occurred at 13 m in the Group II data, but seven partition points chosen during model-fitting procedures smoothed distance data from both groups of sites into acceptable distributions.

## Discussion

Representation of species in the distance data corresponded reasonably well with species composition on the study sites. From point counts conducted along the same transects we knew that Ovenbirds and Black-throated Blue Warblers were the most abundant birds in our study area. Because these species nest on or near the ground and are not highly secretive, they should account for a high percentage of the fledglings detected. The five species detected most often during fledgling surveys (58% of all detections) accounted for 42% of individuals counted in 50-m-radius point counts conducted earlier in the breeding seasons (E. W. Buford, unpublished data).

However, comparison of distance data and point-count data revealed a few cases where species appeared to be misrepresented. Red-eyed Vireos were the third most abundant species on our study area, but accounted for only five fledgling broods. Black-capped Chickadees, on the other hand, were more prevalent in the fledgling surveys than on point counts. We cannot exclude the possibility that poor reproductive success accounted for under-representation of Red-eyed Vireos in the fledgling data, but poor productivity seemed unlikely in these circumstances. As with other field survey methods, distance sampling over-represents species that are more conspicuous and readily detected.

Brown-headed Cowbirds did not appear in our fledgling data. Cowbirds do not occur in heavily forested habitats in Vermont and thus are rare in much of the GMNF (Ellison 1985). Only 4 of 2440 birds detected during point-counts on these transects were cowbirds. A greater abundance of cowbirds might complicate fledgling surveys by introducing the possibility that almost any passerine brood might contain one or more cowbird fledglings.

The jagged appearance of the frequency distributions of our distance data (Figures 1, 2) is typical of biological data and is comparable to some examples illustrated by Buckland et al. (1993). Heaping of distances often occurs when estimating distances rather than taking exact measurements, but this problem was not expected here because we did not estimate distances. Evasive movement also can result in abnormally high frequencies at some distance from the transect. This problem may have caused the spike in our data at 13 m, and had the potential to bias the estimates. Grouping distance data by choosing several reasonably-spaced cutpoints is one procedure for eliminating the adverse effects of heaping or evasive movement. Grouping causes little loss of efficiency and increases estimator robustness when assumptions may have been violated (Buckland et al. 1993).

Our application of transect sampling differs from traditional approaches by representing a suite of species rather than a single species. This feature produces a composite detection function that must meet the same statistical assumptions as a single-species detection function. Shape criteria for the detection function are becoming less stringent as distance sampling theory advances. The main requirement is that objects on the transect are detected with certainty and that detection probability decreases with distance from the transect (Buckland et al. 1993). A multi-species survey properly focused on maximizing detection probability on the transect should meet this requirement.

Coefficients of variation were only slightly more than 10% of the density estimates. This precision indicates that the lack of a statistical difference between Group I and Group II study sites did not result from insufficient power of the test. The bootstrap procedure for calculating standard error was preferred because it provides some indication that the jagged distance distributions have biological meaning and do not represent the consequences of a poorly designed or sloppily executed sampling scheme. Buckland et al. (1993) recommended at least 400 bootstraps for computing standard error.

Several factors might limit the use of line-transect sampling for the estimation of avian productivity. Our study area represents some of the best forest songbird habitat available in the eastern deciduous forest, as indicated by the high diversity of breeding birds present (Robbins et al. 1986). Poor habitats with very low passerine densities may not produce enough detections for meaningful analysis. Similarly, studies focused on the measurement of productivity in small areas might not have sufficient space to meet sample size requirements. Based on a truncation distance of 42 m as an effective transect half-width, our surveyed area was 770 ha. Many studies are conducted in woodlots much smaller than this.

As with other measures of productivity, transect surveys do not perform equally well for all species, and often will not provide enough data to support single-species analyses. In addition, estimating density of fledgling broods — in contrast to nest monitoring — is only an indirect measure of productivity and does not provide any knowledge of clutch size, hatching success, or number of fledglings per brood. Differences in productivity between years may be expressed through variation in fledgling numbers within broods. Differences in productivity between groups might reflect differences in community composition coupled with species-specific variability in productivity. Fledgling density could be made more

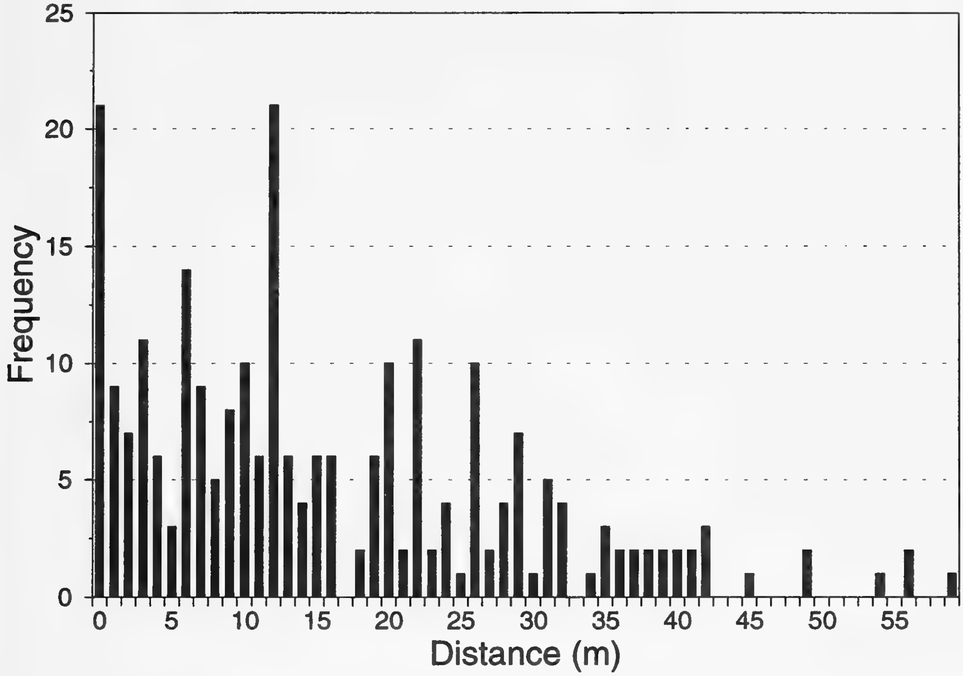


FIGURE 2. Frequency distribution of perpendicular distances measured from 30 line transects to fledgling broods on Group II sites on the Green Mountain National Forest, Vermont, 1993 and 1994. (4 values > 60 m not shown.)

useful by expressing it relative to adult density determined from point counts or other survey methods. Some limitations of these transect surveys can be avoided by looking at relative brood densities, as we have done by comparing two groups.

Despite these limitations, transect sampling is much less obtrusive than nest monitoring or mist-netting, and produces a substantial amount of productivity data with minimal equipment and few observers. Well-staffed projects could cover large areas with line-transect sampling, and longer breeding seasons could result in many more observations per unit area than are reported here. Although sampling over a long breeding season might complicate estimates of density, the results of transect surveys may still serve as useful indices to productivity.

Line-transect sampling of fledglings can add important information to studies of avian communities. No current method alone provides sufficient data. A productivity monitoring scheme might effectively employ line transects in conjunction with mist-netting or nest searches. Transect sampling needs further evaluation and comparison with other methods of gauging avian reproductive success.

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# Parasitic Insect Abundance and Microclimate of Gravel Pads and Tundra Within the Prudhoe Bay Oil Field, Alaska, in Relation to Use by Caribou, *Rangifer tarandus granti*

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During the post-calving period (late June-early August), Caribou (*Rangifer tarandus granti*) movements, distribution, and behavior are significantly influenced by harassment from parasitic insects such as mosquitoes (*Aedes* spp.) and oestrids (Warble Fly [*Hypoderma tarandi*] and Nose Bot Fly [*Cephenomyia trompe*]). A number of studies have mentioned that Caribou use oil field infrastructure features such as gravel pads and roadbeds during insect harassment but there has been no effort to quantify factors contributing to this behavior. During 1992 and 1993 parasitic insect abundance and several weather parameters were measured on active and inactive gravel drilling pads, and undisturbed adjacent tundra in the Prudhoe Bay oil field, Alaska, in an effort to explain use of these man-made structures by Caribou. Ambient air temperatures were lower on gravel pads than adjacent tundra at inactive pads but not at active pad sites. Wind velocities were higher on inactive and active pads than on adjacent tundra. Mosquitos were more abundant on tundra than gravel pads at both active and inactive sites. Mosquito abundance was positively correlated with temperature and negatively correlated with wind velocity and relative humidity at both inactive and active gravel pads. During periods of high insect harassment Caribou were observed using both active and inactive gravel pads.

Key Words: Caribou, *Rangifer tarandus granti*, insect, harassment, microclimate, *Aedes* spp., *Hypoderma tarandi*, *Cephenomyia trompe,* Alaska.

Movements, distribution and behavior of Central Arctic Herd (CAH) Caribou (*Rangifer tarandus*) during post–calving and dispersal periods are influenced by insect harassment (White et al. 1975; Curatolo et al. 1982*[1]; Lawhead 1988). Caribou are harassed by mosquitoes (*Aedes* spp.) during late June or early July through late July and then by oestrid flies (Warble Fly [*Hypoderma tarandi*] and Nose Bot Fly [*Cephenomyia trompe*]) which emerge 2–3 weeks after mosquito emergence and remain active through August (Dau 1986). Oestrid harassment is most severe after mosquito harassment has abated in late July (Kuropat and Curatolo 1983*; Murphy and Curatolo 1987).

Insect harassment can be costly to Caribou health in terms of blood loss, infestation by oestrid fly larvae, and movements to coastal insect-relief habitat or other habitats which may not be in optimal foraging areas (Roby 1978; Dau 1986; Downes et al. 1986). When insect harassment ceases, Caribou return inland to preferred feeding habitat. Such movements are thought to reduce overall energy expenditure by increasing feeding and nursing opportunities, thereby maximizing energy retention (Cameron et al. 1989*).

Insect activity on the Arctic Coastal Plain is influenced by weather conditions. Dau (1986) reported that insect activity on CAH summer range was correlated with ambient-air temperature. Insects were most active during periods of high temperature, low wind velocity, low humidity, and low cloud cover. Caribou move to the Beaufort Sea because it is cooler, windier, and more humid than inland areas (White et al. 1975; Dau 1986). Mosquito activity increases with distance from the coast, whereas oestrid fly activity does not (Dau 1986). Others have also evaluated the effects of weather on mosquito activity in Alaska and northern Canada (Hocking et al. 1950; Gjullin et al. 1961).

A variety of terrain features provide insect–relief habitat for Caribou. When oestrid flies alone harass Caribou, coastal areas apparently offer little or no relief to Caribou (Dau 1986; Lawhead and Smith 1990*). Promontories, pingos, river deltas, gravel bars, sand dunes, and mud flats are frequently used for insect relief (Roby 1978; Dau 1986; Pollard et al. 1990*). Gravel pads within Alaska's North Slope oil fields may mimic naturally occurring elevated insect-relief sites such as pingos. Gravel pads and roads provide insect-relief habitat similar to sparsely vegetated gravel bars and are widely used during the insect season (White et al. 1975; Roby 1978;

[1]References marked with asterisk(*) are listed in separate Documents Cited section following Acknowledgments, all others are in Literature Cited.

Curatolo et al. 1982*; Fancy 1983; Kuropat and Curatolo 1983*; Murphy and Curatolo 1987; Lawhead and Smith 1990*).

In spite of numerous accounts of Caribou using roads and gravel pads for insect-relief, there has been no effort to quantify reasons for apparent differences in insect abundance between gravel pads and adjacent undisturbed areas. The purpose of this study was to quantify insect abundance on gravel pads and adjacent tundra, and attempt to determine factors which influence the use of gravel pads. Our objectives were to quantify mosquito and oestrid fly abundance on gravel pads and adjacent undisturbed tundra; to determine microclimate effects of ambient temperature, wind direction and velocity, and relative humidity on gravel pads and adjacent undisturbed tundra; and to relate mosquito and oestrid fly abundance to differential microclimate conditions on gravel pads and adjacent undisturbed tundra.

## Study Area

The study area (Figure 1) is on the northern edge of Alaska's Arctic Coastal Plain (within 147°50′–149°10′ N longitude and 70°25′–70°10′ W latitude) and is characterized by low relief, many shallow lakes and drained lake basins, and a variety of vegetation types of which wet and moist tundra are dominant (Walker et al. 1980). Summers are short and cool. Summer temperatures are consistently lower along the coast than inland up to 20 km and are influenced by the prevailing east to east–northeast winds (Brown and Hogen 1975; Walker et al. 1980).

Our study area encompassed the Prudhoe Bay Oil Field (PBOF) which is characterized by oil production facilities and supporting infrastructure. Oil Field facilities and roads are built on a gravel base up to 1.6 m thick which insulates the underlying permafrost, thus preventing thawing and subsidence. Among the facilities within the PBOF are 53 producing well pads, 31 non–producing well pads, eight gathering centers, two gravel landing strips for jet aircraft, and two base camps. All facilities are connected by a network of primary and secondary gravel roads totaling approximately 220 km in length.

In 1992, five study sites in the PBOF were selected from exploratory gravel well pads, hereafter called inactive pad sites, (Figure 1): Term Well C, Able State 1, Storage Pad, Lake State 1, and Delta State 2. Gravel pads varied in thickness from approximately 0.3 to 1.6 m, amount of plant colonization (0 to > 50% cover), and proximity to the coast (from 2.4–11.0 km). Only single capped well heads or steel posts marking the site of plugged wells were on the pads. In 1993, in addition to the five inactive pad sites, we selected five active gravel well pad sites: A Pad, D Pad, K Pad, M Pad, and Y Pad (Figure 1). Gravel pads at these sites are generally much larger and thicker (1.6 m on average) than pads at inactive sites. Structures on active pads consisted of numerous well houses enclosing active well heads, pipelines, reserve pits, and large elevated production facilities (modules). All active pads were essentially devoid of vegetation and were from 5.6 to 14.1 km from the coast.

## Methods

We measured mosquito and oestrid fly abundance and weather parameters at the five inactive pad sites daily from 26 June to 4 August 1992. During 1993, weather variables and insect abundance were measured at the same five inactive pads examined during 1992 and an additional five active pad sites from 27 June to 31 July 1993. Each site was visited once daily between the hours of 1000–1730 Alaska Daylight Time (ADT), and contained two sampling stations; one located on the gravel pad (20 m from the edge of the pad) and one located on the tundra (50 m north or northeast of the pad). Because the prevailing winds in summer are from the east–northeast, the sampling station alignment was designed to minimize effects of the gravel pad on the tundra site.

During 1992, ambient air temperatures were recorded every 5 min using Omnidata Datapod® (Logan, Utah) and Dryden R2® (Anchorage, Alaska) electronic data loggers located at each sampling station. Temperature probes (accuracy ±0.25°C), housed in radiation shields, were located at 1.0 m above ground. In 1993, ambient air temperatures were recorded at each sampling station using a hand-held thermometer, equilibrated 15 minutes during each sampling visit.

Wind velocity and direction were recorded daily at 1.0 m above ground using a Davis Turbometer® (Hayward, California) wind speed indicator (accuracy ±0.04 m/s) and a hand–held compass for each sampling station. Velocity was averaged over a 1 min period. Wind direction was recorded as degrees from true north to the nearest 45 degrees. Relative humidity was recorded daily at each sampling station using a sling psychrometer (Forestry Suppliers, Inc., Jackson, Mississippi).

At Lake State 1 site, weather parameters were continuously monitored on the gravel pad and adjacent tundra in 1992 and 1993 with an Omnidata Easylogger® (Logan, Utah) data logging system which recorded and stored data from the following instruments: (1) an RM Young® (Traverse City, Michigan) wind microvane and anemometer which recorded wind velocity (m/s) and wind direction (degrees from true north); and (2) temperature probes which recorded ambient temperatures. Instruments were placed 1.0 m above the gravel pad and tundra surfaces. All temperature and relative humidity probes were housed in plastic radiation shields which allowed for adequate ventilation yet

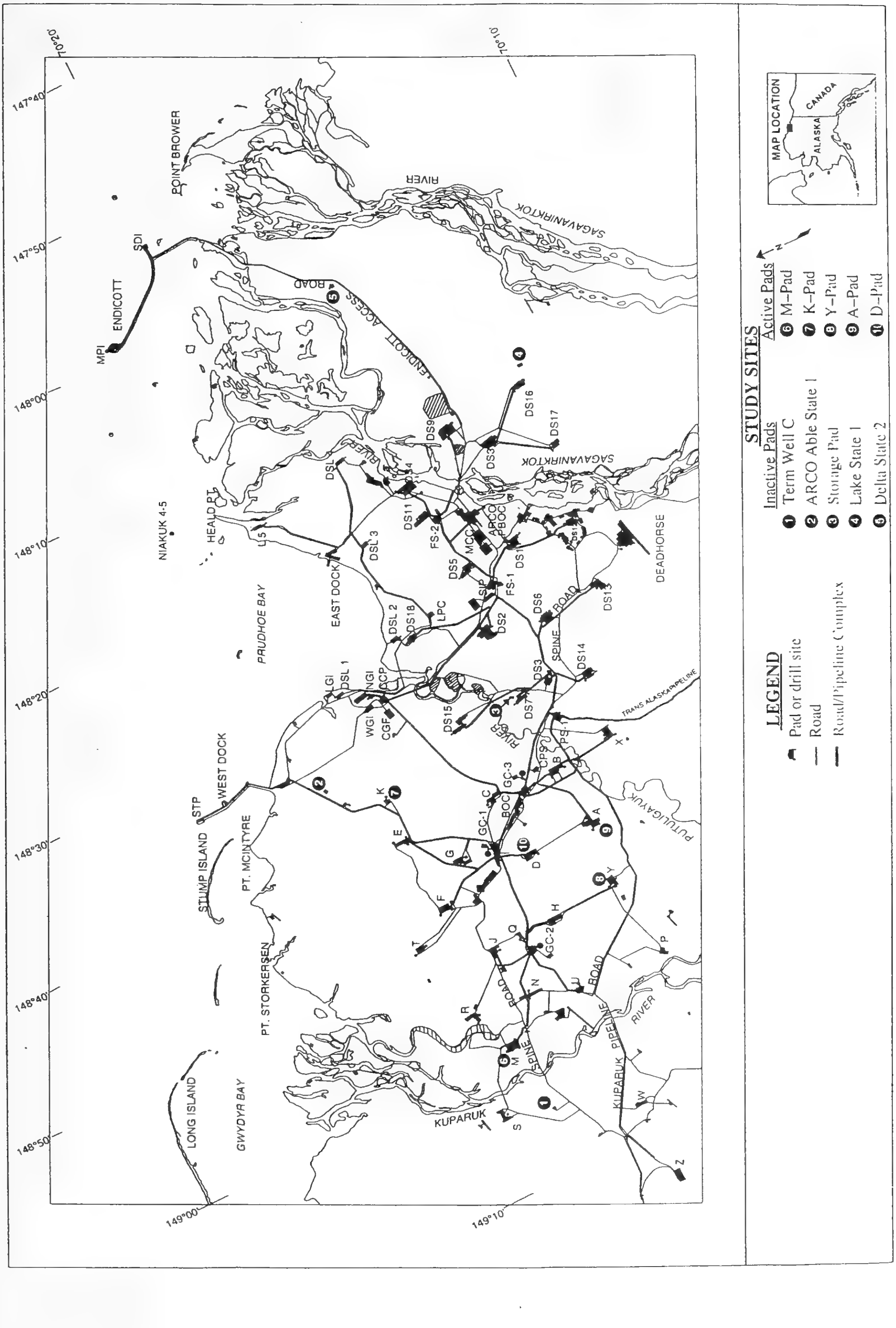


FIGURE 1. Location of study sites in the Prudhoe Bay Oil Field, Alaska.

protected equipment from direct solar radiation and inclement weather.

Insects were sampled daily at each site using sweep nets. Sweeps were conducted at gravel stations first to minimize the chances of insects following researchers to the gravel pad stations. The sweep net consisted of a 0.5 m diameter net bag attached to a 1.5 m aluminum handle. Each sample consisted of 100 sweeps made in a figure–eight motion at approximately one sweep per second; sweeps spanned approximately 0.5 to 2.0 m above ground. The 100 sweeps were composed of 25 sweeps made while walking away from the sampling stations on gravel or tundra in each of the four cardinal compass directions. Mosquitoes and oestrid flies were identified by gross anatomical characteristics, placed in plastic bags and counted daily.

Oestrid fly abundance was also continuously sampled from 16–30 July 1993 using four sticky traps. Each trap consisted of a dried Reindeer hide, coated with Tangle–trap® adhesive, and draped over a wooden sawhorse. At Term Well C (an inactive pad site), one sticky trap was placed near each sampling station on the gravel pad and adjacent tundra. At S Pad (an active pad site), one sticky trap was placed near the sampling station on the pad, and one sticky trap was placed underneath a large module located on the pad. These traps were checked daily and all captured oestrid flies were removed and counted.

Daily temperature, wind velocity, and relative humidity measurements between tundra and gravel pad stations for combined inactive pad sites and combined active pad sites were compared using paired *t*–tests (Snedecor and Cochran 1980). For 1992 data, we used the average temperature over a three-hour period encompassing each sampling visit, recorded by the elctronic data loggers. For 1993, we used the point-in-time temperature measurements recorded during each sampling visit.

Data collected during 1992 and 1993 were analyzed seperately and, where appropriate, pooled. We conducted a single paired *t*–test (for each weather parameter measured) that included data from all inactive pad sites to compensate for variation among inactive pad sites. We also conducted a single paired *t*–test that included data from all active pad sites to compensate for variation among active pad sites. Due to the distinct physical differences between inactive pad sites and active pad sites, these data were not combined. Spearman rank correlations were used to determine correlations among weather parameters, mosquito abundance, and distance to coastline. Wilcoxon paired–sample tests were used to determine differences in mosquito and oestrid fly abundance at gravel pad versus tundra stations. Two–sample chi–square tests (Zar 1984: 145) were used to evaluate differences in median wind direction between gravel pad and tundra stations for each site. Raw insect and weather data are contained in Pollard and Ballard (1983) and Pollard and Noel (1984).

All statistical analyses were conducted using the software packages SYSTAT® (Evanston, Illinois) and STATISTIX® (St. Paul, Minnesota).

## Results

### Weather Variables – Gravel Pads vs. Tundra

#### *Inactive Pad Sites*

Ambient air temperatures were higher ($P < 0.001$) on tundra than on gravel pads in 1992 ($\bar{x} = 6.6$°C, SE = 0.3 and $\bar{x} = 6.4$°C, SE = 0.32, respectively) and 1993 ($\bar{x} = 11.4$°C, SE = 0.4 and $\bar{x} = 11.2$°C, SE = 0.3, respectively). Similar results were obtained ($P < 0.001$) when data from both years were pooled. Daily mean temperatures recorded by the data logger at the Lake State 1 study site in 1993 were also higher ($P = 0.008$) on tundra ($\bar{x} = 9.3$°C, SE = 0.6) than on the gravel pad ($\bar{x} = 9.2$°C, SE = 0.5). The range of daily temperature differences between gravel pads and tundra at any one site was 0.0–1.6°C in 1992 and 0.0–6.8°C in 1993. Overall and at individual sites, relative humidity was higher on gravel pads ($\bar{x} = 78.3\%$, SE = 0.9) than on tundra ($\bar{x} = 77.7\%$, SE = 0.9) in 1992, but this difference was not significant ($P = 0.059$). In 1993, daily relative humidity measurements were not different ($P = 0.54$) between gravel pads ($\bar{x} = 82.4\%$, SE = 1.0) and tundra ($\bar{x} = 82.1\%$, SE = 1.0).

Wind velocities were higher ($P < 0.001$) on gravel pads than on tundra in 1992 ($\bar{x} = 3.7$ m/s, SE = 0.13 and $\bar{x} = 3.2$ m/s, SE = 0.1, respectively) and 1993 ($\bar{x} = 3.6$ m/s, SE = 0.1 and $\bar{x} = 3.2$ m/s, SE = 0.1, respectively). This was also true ($P < 0.001$) for pooled data and for wind velocity data recorded by weather stations on gravel and tundra at Lake State 1 in 1992 ($\bar{x} = 3.8$ m/s, SE = 0.3 and $\bar{x} = 3.2$ m/s, SE = 0.3, respectively) and 1993 ($\bar{x} = 3.4$ m/s, SE = 0.2 and $\bar{x} = 2.9$ m/s, SE = 0.2, respectively). The range of wind velocity differences between gravel pads and tundra at any one site ranged from 0.0 to 2.8 m/s in 1992 and from 0.0 to 8.6 m/s in 1993. There was no significant difference ($P > 0.05$) in median wind direction between gravel pads and tundra for any of the five sites in both years of study.

Temperature and relative humidity were negatively correlated on gravel pads ($r = -0.6$, $P < 0.05$) and tundra ($r = -0.6$, $P < 0.05$) but wind velocity and relative humidity were not. Temperature and wind velocity were negatively correlated ($r = -0.2$, $P < 0.05$) on gravel pads, but not on tundra in 1992 and for neither of the sites in 1993.

#### *Active Pad Sites – 1993*

Temperatures were similar ($P = 0.920$) on tundra ($\bar{x} = 11.8$°C, SE = 0.4) and gravel pads ($\bar{x} = 11.8$°C, SE = 0.4). Temperature measurements ranged from 2.3 to 22.9°C, and differences between temperatures

TABLE 1. Comparison of sweep net counts of mosquitoes between tundra and gravel sites at five inactive pad sites in the Prudhoe Bay Oil Field, during 1992 and 1993.

| | Number (%) of mosquitoes | | | | |
|---|---|---|---|---|---|
| | 1992 | | 1993 | | |
| Site | Tundra | Gravel | Tundra | Gravel | Total |
| Able State | 148(13) | 29(5) | 385(8) | 39(2) | 601(7) |
| Storage Pad | 70(6) | 54(9) | 709(15) | 461(20) | 1294(15) |
| Term Well C | 227(21) | 171(29) | 821(17) | 138(6) | 1348(15) |
| Delta State | 333(30) | 79(13) | 1411(29) | 526(22) | 2349(26) |
| Lake State 1 | 329(30) | 253(43) | 1557(32) | 1190(51) | 3329(37) |
| Total | 1107 | 586 | 4874 | 2354 | 8921 |

at gravel and tundra stations ranged from 0.0 to 4.1°C.

Wind velocities were significantly higher ($P$ = 0.005) on gravel pads ($\bar{x}$ = 3.1 m/s, SE = 0.1) than on tundra ($\bar{x}$ = 2.9 m/s, SE = 0.1). Velocity measurements ranged from 0.0 to 9.3 m/s, and differences between wind velocity on gravel pads and tundra ranged from 0.0 to 6.3 m/s. There were no significant differences ($P$ > 0.05) in median wind direction between gravel pads and tundra for any of the five active pad sites. Median wind direction, all sites combined, was northeast (45°) for active pad sites.

Daily relative humidity measurements were similar ($P$ = 0.478) on gravel pads ($\bar{x}$ = 82.2%, SE = 1.0) and tundra ($\bar{x}$ = 82.5%, SE = 0.1). Relative humidity ranged from 36 to 100%, and differences in humidity between gravel pads and tundra ranged from 0 to 2%.

Temperature and relative humidity were negatively correlated on tundra ($r$ = -0.8, $P$ < 0.05) and gravel pads ($r$ = -0.8, $P$ < 0.05) but there were no significant correlations between temperature and wind velocity or relative humidity and wind velocity.

Insect Abundance and Relationships with Weather

*Inactive Pad Sites*

Mosquito abundance was low (i.e., 0-4 mosquitoes per day [mpd]) from 26 June through 7 July 1992. On 8 July mosquito abundance peaked (840 mpd). A second peak (268 mpd) occurred on 19 July. Other than these two peaks, mosquitoes were moderately active on 9–11 July (57–169 mpd), 18 July (79 mpd), and 20–23 July (24–100 mpd). After 23 July, mosquito levels were relatively low at all study sites. Mosquitoes were more abundant ($P$ < 0.001) on tundra ($\bar{x}$ = 31.4, SE = 14.3) than on gravel pads ($\bar{x}$ = 16.9, SE = 9.7). Sweep net counts of mosquitoes were higher on tundra than on gravel 21 of 25 days (84%) on which mosquitoes were caught. High winds on 4–6 July precluded sweep net sampling of insects.

In 1993, mosquito abundance was moderate–to–high on 28–29 June (384 and 451 mpd, respectively), 3–4 July (78 and 260 mpd, respectively), 7–9 July (197 and 436 mpd, respectively), 11–12 July (476 and 467 mpd, repectively), and 14 July (194 mpd), with abundance peaking on 5 July (3048 mpd) and 10 July (651 mpd). After 15 July, mosquito levels were relatively low at all study sites. Sweep net counts of mosquitoes were higher on tundra than gravel pads 22 of 29 days (76%) when mosquitoes were caught. Mosquitoes were more abundant ($P$ = 0.002) on tundra ($\bar{x}$ = 139.3 mpd, SE = 60.6) than on gravel pads ($\bar{x}$ = 67.3 mpd, SE = 29.5).

There was considerable variation among sites relative to total numbers of mosquitoes captured (Table 1). The highest number of mosquitoes occurred at the Lake State 1 site (37%) followed by Delta State 2 (26%) and Storage Pad and Term Well C (15% each). Able State 1 had the lowest number of mosquitoes overall (7%).

Mosquito activity was positively correlated with air temperature (tundra - $r$ = 0.6, $P$ < 0.05; pads - $r$ = 0.5, $P$ < 0.05) and negatively correlated with relative humidity (tundra - $r$ = -0.3, $P$ < 0.05; pads - $r$ = -0.3,

TABLE 2. Minimum and maximum weather variable values at which mosquitoes were caught at inactive pad sites in the Prudhoe Bay Oil Field, Alaska, during 1992 and 1993.

| | 1992 | | | 1993 | | |
|---|---|---|---|---|---|---|
| Weather Variable | Min | Max | n | Min | Max | $n$ |
| Temperature (°C)* | 3.5 | 25.4 | 89 | 4.6 | 21.9 | 159 |
| Wind Velocity (m/s) | 0 | 5.3 | 100 | 0.2 | 6.8 | 159 |
| Relative Humidity (%) | 29 | 97 | 99 | 45 | 100 | 152 |

*averaged over a 3-hour period encompassing sampling visits in 1992.

$P < 0.05$) and wind velocity (tundra - $r = -0.2$, $P < 0.05$; pads $r = -0.3$, $P < 0.05$). Similar results were obtained for individual years. Periods of maximum mosquito activity coincided with periods of high ambient temperature, low wind velocity and low relative humidity.

The minimum temperature at which mosquitoes were caught at any one site in 1992 was 3.5°C and the maximum was 25.4°C (Table 2). Mosquitoes were active with totally calm conditions (0.0 m/s) up to a maximum wind velocity of 5.3 m/s. Minimum relative humidity at which mosquitoes were caught was 29% and the maximum was 97%. The minimum temperature at which mosquitoes were caught at any inactive pad site in 1993 was 4.6°C, and the maximum was 21.9°C. Mosquitoes were active at wind velocities of 0.2–6.8 m/s, and relative humidities of 45–100% (Table 2).

During1992, no oestrid flies were caught during sweep net sampling. In 1993, no oestrid flies were caught on inactive pad sites at gravel pad stations during sweep net sampling, and only three Warble Flies were caught in sweep nets on tundra stations adjacent to the pads. In contrast, sticky traps at the Term Well C site were more effective in capturing oestrids. Warble Flies were captured on 13 of 15 days (87%), and Bot Flies were captured on 8 of 15 days (53%). Peaks in catches occurred on 16 July (38 oestids), 19 July (52 oestrids), and 21 July (30 oestrids). On all other days, between 0-19 oestrid per day were captured. More ($P = 0.002$) oestrids were captured on the tundra sticky trap (total = 152, $\bar{x}$ = 10.1, SE = 2.9) than on the gravel pad sticky trap ($n$ = 54, $\bar{x}$ =3.6, SE = 1.4).

*Active Pads Sites-1993*

Mosquito abundance was low on 27 June, 1–2 July, 6 July, 13 July, and 15–31 July (0–49 mpd). Moderate–to–high levels ($\bar{x}$ =182 mpd) occurred 28–30 June, 3–4 July, 7–10 July, 12 July, and 14 July, with peak abundance on 5 July (852 mpd) and 11 July (652 mpd). After 15 July, mosquito levels were relatively low at all study sites (0–25 mpd). Sweep net counts of mosquitoes were higher ($P < 0.001$) on tundra ($\bar{x}$ = 96.2 mpd, SE = 29.8) than on gravel pads ($\bar{x}$ = 9.7 mpd, SE = 3.1) on all days ($n$ = 27) when mosquitoes were caught.

Mosquito activity was positively correlated with air temperature (tundra - $r = 0.6$, $P < 0.05$; pads - $r = 0.4$, $P < 0.05$) and negatively correlated with wind velocity (tundra - $r = -0.2$, $P < 0.05$; pads - $r = -0.3$, $P < 0.05$) and relative humidity (tundra - $r = -0.5$, $P < 0.05$; pads - $r = -0.4$, $P < 0.05$). The minimum temperature at which mosquitoes were caught at any active pad site was 5.4°C, and the maximum was 22.9°C. Mosquitoes were active at wind velocities of 0.0–6.7 m/s, and relative humidities of 47–100%.

Only two Warble Flies were collected in sweep nets, one on the gravel pad station at A Pad and one on the tundra station at M Pad on 21 July and 11 July, respectively. Oestrid flies were collected from 16–30 July on sticky traps set at the gravel pad station and under the module at S Pad. No Warble or Bot Flies were caught on the sticky trap set in the shade of the module. Warble Flies were caught on the gravel pad 5 of 15 days (33%) and Bot Flies were caught 3 of 15 days (20%). Peaks in oestrid catches occurred on 19 July (11 oestrids) and 20 July (5 oestrids).

*Weather/Insect Relationships Relative to Distance from Coast*

Mosquito abundance and weather variables on five tundra stations in 1992 and ten tundra stations in 1993 were evaluated in terms of proximity to the Beaufort Sea coast. Tundra stations at inactive pad sites ranged from 2.4–11.7 km from the coast while tundra stations at active pad sites ranged from 5.6–14.1 km from the coast. In 1992, wind velocity and relative humidity were negatively correlated ($r$ = -0.9, $P < 0.04$) with distance from the coast but there was no correlation between mosquito abundance and distance from coast, or temperature and distance from the coast. In 1993, relative humidity was negatively correlated ($r = -0.7$, $P = 0.03$) and temperature was positively correlated ($r = 0.79$, $P = 0.006$) with distance from the coast. There was no significant correlation between wind velocity and distance from coast or mosquito abundance and distance from coast.

## Discussion

Insect Abundance and Climatic Conditions

Several physical differences between inactive and active pads may have effected our results. These included: active gravel pads were higher than inactive pads due to a thicker gravel layer; and oil production structures, including well houses and production modules, are common on active pads but absent on inactive pads. Structures on active pads provide shade and block winds, both of which probably influence microclimate.

For inactive gravel pad sites, ambient air temperature was higher and wind velocity was lower on tundra than on gravel pads. Differences in temperature may be rel ted to the reflectance characteristics of the two meaiums. Gravel pads are well-drained and are composed of a mixture of various sizes of gravel and sand. These materials exhibit a characteristically higher reflectance of incoming solar radiation and a lower emissivity than green vegetation at tundra sites (Lillesand and Kiefer 1979). Emissivity is a measure of an object's ability to radiate energy and is a function of temperature. For active pad sites, there was no difference in ambient air temperatures between

gravel and tundra, possibly due to the influence of structures (well houses, pipelines, and modules) on wind velocities at the pads, even though wind velocities were higher on gravel pads than on tundra. Higher wind velocities on gravel pads were likely due to a "gradient" effect. Wind velocity increases with elevation (Snow 1976) and gravel pads are higher than adjacent tundra. During both years, there were no differences in wind direction or relative humidity between gravel pads and tundra stations at inactive pad sites. This was also true for active pad sites.

Relative humidity was negatively correlated with temperature, but not with wind velocity. Identical findings were reported by Dau (1986) and Nixon (1990). In 1992, temperature was negatively correlated with wind velocity on gravel pads but not on tundra. However, for both gravel pads and tundra, no correlation was found between these two variables in 1993 or when data were pooled. Dau (1986) and Nixon (1990) also did not find correlations between temperature and wind velocity.

During 1993, temperature increased with distance from the Beaufort Sea coast, while relative humidity decreased with distance from the coast for tundra stations at inactive and active pad sites combined. Dau (1986) reported correlations between temperature and humidity with distance from the coast. During 1992 wind velocity and relative humidity decreased with distance from the coast, while temperature was not correlated. Dau (1986) and Searby and Hunter (1971) also reported a negative correlation between wind velocity and distance to coast. In contrast, there was no correlation between wind velocity and distance during 1993.

Dau (1986) reported that mosquito activity increased with distance from the Beaufort Sea coast (for five sites in roughly north–south alignment). We found no significant relationship between mean number of mosquitoes in sweep nets and distance from the Beaufort Sea coast for either 1992 or 1993. Other site attributes, such as proximity to waterbodies or distance to the coast measured with regard to prevailing wind direction, may be more relevant.

Insect activity in arctic areas is a function of at least two weather variables, i.e., temperature and wind (Curatolo 1975*; White et al. 1975; Roby 1978; Dau 1986). Mosquito abundance was correlated with temperature, wind velocity, and relative humidity for both inactive and active pad sites. Temperature and mosquito abundance had the highest correlation coefficient for both 1992 and 1993, similar to Dau's (1986) findings. Nixon (1990) reported that the average mosquito catch was more strongly correlated with wind velocity than temperature. But Nixon (1990) also found a highly significant quadratic regression ($r^2 = 0.92$) for the proportion of samples containing mosquitoes with the temperature. Peaks in mosquito abundance appear to correspond with periods of high ambient air temperature, low wind velocity, and low relative humidity in both 1992 and 1993.

The minimum air temperature (4.6°C) at which mosquitoes were caught in 1993 was similar to the 4.4°C minimum reported by Gjullin et al. (1961) but higher than the minimum recorded in 1992 (3.5°C). Other studies have suggested that mosquitoes are more active at temperatures above 6-7°C (White et al. 1975; Roby 1978; Nixon 1990). The maximum air temperature (21.9°C) at which mosquitoes were caught in 1993 was slightly lower than that recorded in 1992 (25.4°C) and both maximums were lower than the 26°C upper threshold identified by Dau (1986). The maximum wind speed at which mosquitoes were caught was slightly higher in 1993 (6.8 m/s) than in 1992 (5.3 m/s) and higher than the 4.5 m/s maximum reported by Gjullin et al. (1961). However, it is similar to the 6 to 7 m/s range reported by Roby (1987), Dau (1986), and Nixon (1990).

Mosquito abundance was higher on tundra than on inactive gravel pad stations during both years of study. Active pad sites also had higher mosquito abundance at tundra stations in 1993. Reduced mosquito abundance on gravel pads was probably due to higher wind velocities, lower ambient temperatures, and poor insect cover habitat on gravel pads. Although plant colonization has occurred on some inactive pads, there were no sizable (i.e., > 5 m$^2$) contiguous stands of vegetation on the gravel pads at any of our study sites except Lake State 1, which was part of an earlier restoration project (Jorgenson 1988*). Interestingly, proportionately more mosquitoes were captured at this site than at any of the other four sites. Vegetation provides resting habitat and escape cover for mosquitos during periods of inclement weather (White et al. 1975; Linkswiler and Curatolo 1984*; Dau 1986).

Dau (1986) reported annual variation in the proportion of days mosquitoes were active. For example, in 1982 he caught mosquitoes on 64% of sampling days and in 1983 on 85% of sampling days. In our study, mosquitoes in any number were captured on 68% of sampling days in 1992 and on 86% of sampling days in 1993. MacLean (1975) suggested that annual variability in mosquito abundance may be related to difference in air temperatures as much as actual differences in abundance. Indeed, daily mean temperatures, on both gravel pads and tundra and over the entire sampling period, were 4.8°C higher, on average, in 1993 than in 1992.

Active pad sites generally had fewer mosquitoes than inactive pad sites. Site specific differences in amount of available larval habitat; i.e., temporary marsh pools (dry four to five weeks after spring break up) and semipermanent pools (dry for at least a short period during July or August) (Gjullin et al.

1961), may account for some of the differences. Perhaps road dust created by vehicular traffic at active pad sites may also influence mosquito abundance by reducing adult resting and cover habitat quality (vegetation dusting) or by coating pool surfaces and inhibiting larval respiration.

Several reasons exist for our low success rate for capturing oestrid flies using sweep nets. In arctic environments oestrids have a clumped distribution, occur in low densities, and are much less ubiquitous than mosquitoes (Dau 1986; Curatolo 1975*). Dau (1986) also did not catch oestrids using sweep nets and caught only low numbers in sticky traps relative to mosquito catches. Nixon (1990) was unsuccessful in capturing oestrids using Malaise traps even when using $CO_2$ as an attractant.

In our study, as with Dau's (1986), sticky traps were more successful in capturing oestrids. Oestrids were significantly more numerous on the tundra station sticky trap than on the adjacent gravel pad. No oestrids were collected on the sticky trap placed in the shade of the module at S Pad, but oestrids were collected on the sticky trap placed on the gravel pad nearby. There is some evidence that oestrids are shade–intolerant. Espmark (1968), in fact, noted that Reindeer may stand under the shade of a thick–branched tree to avoid oestrid flies. Dau (1986) suggested oestrid fly distribution was influenced by Caribou distribution. Oestrids locate hosts more efficiently than mosquitoes because they use olfaction and warm convection currents associated with warm–blooded animals to locate Caribou (Roby 1978). Our S Pad sticky trap data appear to support Dau's conclusions. On four of the five days oestrids were caught on the sticky trap at S Pad, Caribou were sighted on or near S Pad during road surveys (Pollard and Noel 1994, unpublished data). On one occasion, a group of Caribou that was observed running from a tundra area up onto the pad, aggregated under the module where our sticky trap was located. Interestingly, the cloud of oestrid flies that had apparently elicited this behavior, stopped short of the module and would not fly under this structure. The highest number of oestrids were caught on the day (19 July 1993) when the most Caribou were observed on the pad.

During insect–free periods, movements of Caribou are related to gaining access to preferred forage (White et al. 1975). Caribou disperse inland during oestrid harassment (Lawhead and Curatolo 1984*; Lawhead 1988; Dau 1986) and may expend large amounts of energy avoiding insects (Dau 1986). If insect harassment is particularly severe, energy deficits, resulting from increased running and less time feeding, may affect the survival of animals during winter and calves during summer (Curatolo 1975*). Availability of man–made insect–relief habitats (i.e., gravel pads and roads) may allow Caribou to remain in preferred foraging habitat, thereby lessening the energy demands imposed on Caribou during the insect season.

Dau (1986) indicated that natural insect–relief habitat is limited to within 3 km of the Beaufort Sea coast, and that the area within 1 km is probably of highest value to Caribou. Apparently, coastal areas do not afford much relief from oestrid harassment (Lawhead and Smith 1990*) and naturally occurring oestrid–relief terrain (e.g., gravel bars, pingos) is limited on the Arctic Coastal Plain (Dau 1986). Furthermore, the quantity and quality of forage may be substantially lower along the coast than inland (White et al. 1975; Dau 1986).

Use of oil field facilities by Caribou to ameliorate oestrid harassment is well documented (White et al. 1975; Curatolo et al. 1982*; Fancy 1983; Curatolo and Murphy 1986; Dau 1986; Johnson and Lawhead 1989*; Lawhead and Smith 1990*). During insect harassment Caribou are less sensitive to oil field facilities and activities than at other times (White et al. 1975; Curatolo et al. 1982*; Dau 1986; Murphy and Curatolo 1987). Indeed, the dominating influence of oestrids often overrides any tendency to avoid development related structures and/or activities (Pollard et al. 1992*). Reduced mosquito and oestrid abundance on gravel pads, and absence of oestrids in the shade of a module, indicate that gravel pads and structures on pads offer insect-relief habitat because these sites are windier, drier, and have less vegetative cover.

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# Summer Distribution of Caribou, *Rangifer tarandus granti*, in the Area of the Prudhoe Bay Oil Field, Alaska, 1990-1994

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Aerial surveys were conducted within the Prudhoe Bay oil field area in northern Alaska during 1990-1994 to document summer distribution of Caribou (*Rangifer tarandus granti*). Numbers of Caribou observed per survey ranged from 34 to 13058. When insect activity was moderate to high, more Caribou were observed within the oil field than when insect activity was low. Severe mosquito (*Aedes* spp.) harassment often resulted in large post-calving aggregations of Caribou in coastal areas. When mosquito harassment subsided, aggregations often moved inland through the oil field or laterally along the coast. On several occasions, large groups of Caribou (2000-4000 individuals) were observed feeding or bedded down in the central portion of the oil field. Caribou were observed on, and used, oil field gravel pads and roads as insect relief habitat during the mosquito season in late June through mid-July, and also used the shade of oil field structures when oestrid flies (*Hypoderma tarandi* and *Cephenomyia trompe*) were abundant from mid-July to early August. Five years of observations document that Caribou use habitat within and travel through oil fields during summer during periods of high insect activity.

Key Words: Caribou, *Rangifer tarandus granti*, Prudhoe Bay, Alaska, insect harassment, oestrid flies, mosquitoes, post-calving, oil field, aerial survey.

The potential impacts of oil field development on Caribou (*Rangifer tarandus granti*) of the Central Arctic Herd (CAH) has been the focus of intensive research in Alaska's North Slope oil fields since the early 1970s (Clough et al. 1987). Effects of oil fields on movements and habitat-use patterns have been of particular concern (Cameron and Whitten 1976*, 1980; Klein 1980; Curatolo and Murphy 1986; Cameron et al. 1992). The CAH has grown from about 5000 animals in 1975 (Cameron and Whitten 1979*) to 23444 animals in 1992 (Cameron 1993*) and numbered 18093 in 1995 (P. Valkenburg, Alaska Department of Fish and Game, personal communication). The CAH generally winters in the northern foothills of the Brooks Range and migrates each spring to calving grounds and summer range on the Arctic Coastal Plain between the Itkillik and Colville rivers (151°00'W longitude) on the west to the Sadlerochit River (145°00'W longitude) on the east (Clough et al. 1987). The Prudhoe Bay oil field (PBOF) is located within the summer range of the CAH.

During the calving period, the CAH segregates into segments east and west of the Sagavanirktok River (Cameron and Whitten 1977*; Lawhead 1988). The western segment uses the area in and around the Kuparuk oil field during the post-calving period. The eastern segment uses areas to the east of the PBOF. A 1992 photocensus of the CAH estimated 8602 animals in the eastern segment and 14 842 animals in the western segment (Valkenburg 1993*). The most recent photocensus in 1995 indicated 11 634 animals in the eastern segment and 6459 in the western segment (P. Valkenburg, Alaska Department of Fish and Game, personal communication).

During the calving period female Caribou with calves may distance themselves from oil field facilities such as roads (Whitten and Cameron 1985; Dau and Cameron 1986; Klein 1991; Cameron et al. 1992). However, the Kuparuk and Milne Point oil field areas west of the PBOF have not been abandoned, as calving has continued in these areas concurrent with expanding oil field development (Cameron et al. 1992). There is little information on use of the PBOF for calving prior to oil field development in 1970, but it is believed that it was not a concentrated calving area (Child 1973*; Gavin 1983*; Whitten and Cameron 1985; Klein 1991). Furthermore, Whitten and Cameron (1985) suggested that the generally wet conditions in the PBOF area (between the Kuparuk and Sagavanirktok rivers) provides suboptimal calving habitat. CAH Caribou use snow-covered lowlands or well-drained uplands over river valleys or deltas for calving (Carruthers et al. 1987).

*Unpublished, see Documents Cited section following Acknowledgments. All other dates are to published references given in Literature Cited.

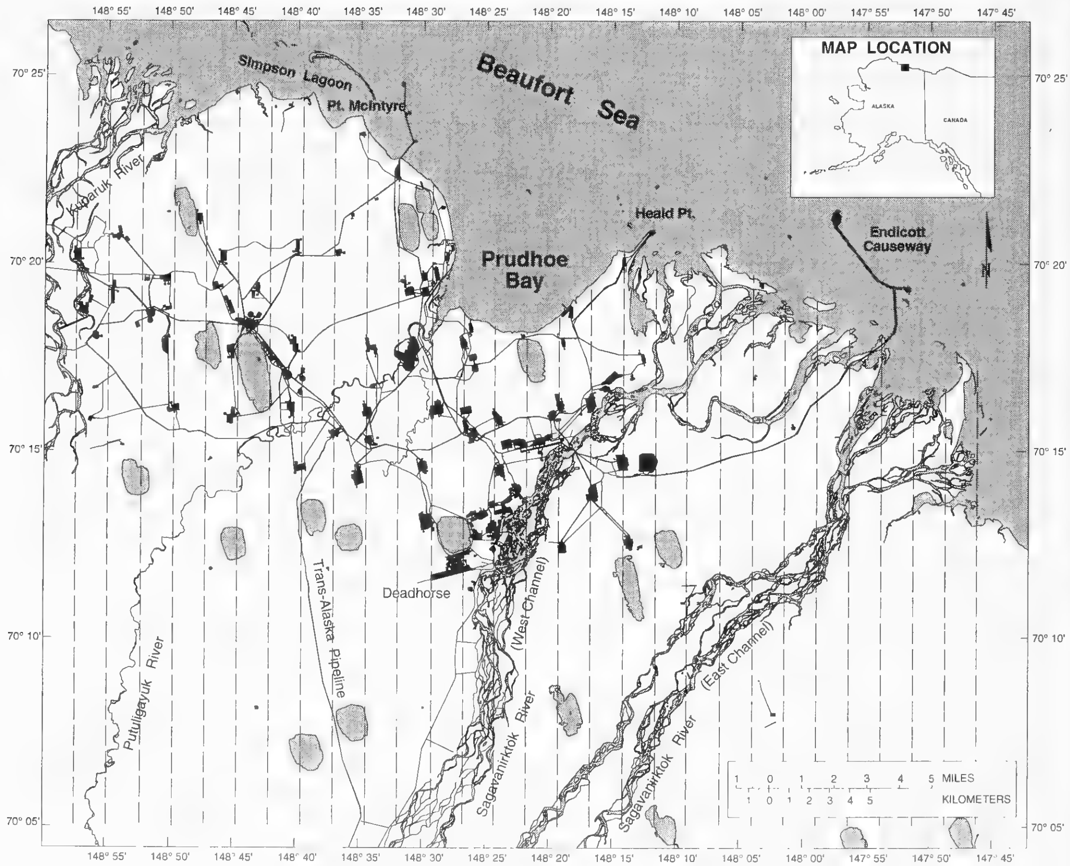



FIGURE 1. Location of strip-transect centerlines for aerial surveys conducted between 26 June and 8 August, 1990-1994, Prudhoe Bay oil field, Alaska. Solid lines are roads or pipelines and rectangles are gravel pads which support oil field facilities.

In contrast to the calving period, the PBOF may have been used frequently by Caribou during the post-calving period (late June through early August) prior to oil field development (Child 1973*; Whitten and Cameron 1983*a*). Child (1973*:7) identified extensive "traditional trail systems of Caribou" in the area that is now the PBOF. Whitten and Cameron (1985) and Johnson and Lawhead (1989*) suggested that, since the mid-1970s, movements by large post-calving aggregations through the PBOF have become rare or ceased entirely. However, harassment by mosquitoes and oestrid flies (warble flies, *Hypoderma tarandi* and nose bot flies, *Cephenomyia trompe*) have a large influence on Caribou post-calving distribution and movements (White et al. 1975; Curatolo et al. 1982*; Lawhead 1988), and there is evidence that the oil field areas may provide relief habitat from insects (Pollard et al. 1996).

There is interest in expanding oil field development in arctic Alaska, including areas within the Arctic National Wildlife Refuge used as calving and post-calving habitat by the Porcupine Caribou Herd (Clough et al. 1987). Because impact assessments at existing oil fields will be used to infer potential impacts at new developments, it is important to document accurately the extent of post-calving use of the PBOF. The objectives of this study were to quantify the post-calving distribution and number of Caribou in the area of the PBOF over five years and relate caribou distribution and numbers to insect activity.

## Study Area

The study was conducted on the northern edge of the Arctic Coastal Plain of Alaska north of 70°05′N latitude between the Kuparuk and Sagavanirktok rivers (Figure 1). The 1394 km$^2$ study area contains the PBOF and is characterized by little elevational relief, many shallow lakes and drained lake basins, and a variety of vegetation types dominated by wet and moist tundra (Walker et al. 1980).

The PBOF includes 53 producing well pads, 31 exploration pads, 8 gathering centers, 2 gravel land-

TABLE 1. Estimated numbers and sex/age composition of Caribou in relation to relative insect activity observed during aerial surveys conducted in the Prudhoe Bay study area, Alaska, during the post-calving period, 1990-1994.

| Year Date | Bulls | Cows | Calves | Yearlings | Unclassified | Total | Relative Insect Activity[a] |
|---|---|---|---|---|---|---|---|
| 1990 | | | | | | | |
| 4,5 July | 3151 | 4203 | 2947 | 563 | 3 | 10867 | high |
| 12 July | 60 | 14 | 4 | 2 | 2 | 82 | low |
| 19 July | 253 | 372 | 179 | 58 | 66 | 928 | low |
| 26 July | 44 | 35 | 9 | 1 | 20 | 109 | low |
| 1 August | 77 | 45 | 12 | 1 | 24 | 159 | low |
| 1991 | | | | | | | |
| 26 June | 137 | 27 | 23 | 29 | 51 | 267 | low |
| 3 July | 259 | 25 | 25 | 8 | 53 | 370 | low-moderate |
| 10 July | 268 | 156 | 121 | 6 | 230 | 781 | low |
| 16 July | 2151 | 1801 | 1797 | 0 | 1330 | 7079 | moderate |
| 25 July | 522 | 108 | 96 | 7 | 732 | 1465 | low |
| 31 July | 35 | 12 | 7 | 2 | 76 | 132 | low |
| 1992 | | | | | | | |
| 9 July | 2535 | 2746 | 2641 | 427 | 1982 | 10331 | high |
| 10 July | 4074 | 3242 | 3186 | 346 | 2210 | 13058 | moderate |
| 13, 14 July | 72 | 24 | 23 | 9 | 19 | 147 | low |
| 19 July | 2503 | 1579 | 1572 | 452 | 1538 | 7644 | high |
| 23 July | 566 | 428 | 405 | 91 | 446 | 1936 | high |
| 25 July | 826 | 541 | 530 | 78 | 528 | 2503 | high |
| 28 July | 254 | 96 | 92 | 10 | 141 | 593 | moderate |
| 31 July | 44 | 23 | 18 | 2 | 60 | 147 | low |
| 1993 | | | | | | | |
| 1 July | 1315 | 434 | 209 | 171 | 113 | 2242 | low |
| 6 July | 60 | 10 | 3 | 2 | 0 | 75 | low |
| 10 July | 438 | 727 | 713 | 0 | 1210 | 3088 | high |
| 17 July | 190 | 454 | 252 | 52 | 215 | 1163 | moderate |
| 19 July | 2055 | 625 | 542 | 145 | 430 | 3797 | high |
| 26 July | 52 | 31 | 10 | 0 | 3 | 96 | low |
| 1994 | | | | | | | |
| 5 July | 129 | 55 | 40 | 11 | 41 | 276 | [b] |
| 11 July | 804 | 922 | 562 | 54 | 257 | 2599 | [b] |
| 19 July | 138 | 97 | 64 | 6 | 44 | 349 | [b] |
| 26 July | 18 | 12 | 2 | 0 | 2 | 34 | [b] |
| 31 July | 198 | 496 | 386 | 18 | 119 | 1217 | [b] |
| 7,8 August | 32 | 36 | 9 | 1 | 1 | 79 | [b] |

[a]Quantified in detail by Pollard et al. (1996).
[b]Insect activity not monitored.

ing strips for jet aircraft, and 2 base camps. Other service facilities are present both in the oil field and the nearby community of Deadhorse. All facilities are supported by elevated gravel pads (approximately 1.5 m) and are connected by a network of gravel roads (totaling approximately 220 km in length) and above-ground pipelines.

Our study area included the entire PBOF complex, and also considerable area surrounding the oil field (Figure 1). For example, the southeast, southwest, and northwest portions of the study area have large areas which are distant from oil field infrastructure. A detailed assessment of Caribou distribution in relation to infrastructure is beyond the scope of this report, and will be described elsewhere. The results of that analysis show no evidence of avoidance of infrastructure by Caribou. Here we are concerned with the numbers, distribution, and movements of caribou relative to the PBOF as a whole. For this paper, we will loosely define the PBOF as the area within 10 km of roads and oil field infrastructure.

## Methods

During 1990-1994 between 26 June and 8 August, we conducted a series of aerial surveys of the study area from fixed-wing aircraft (Cessna 206) with two

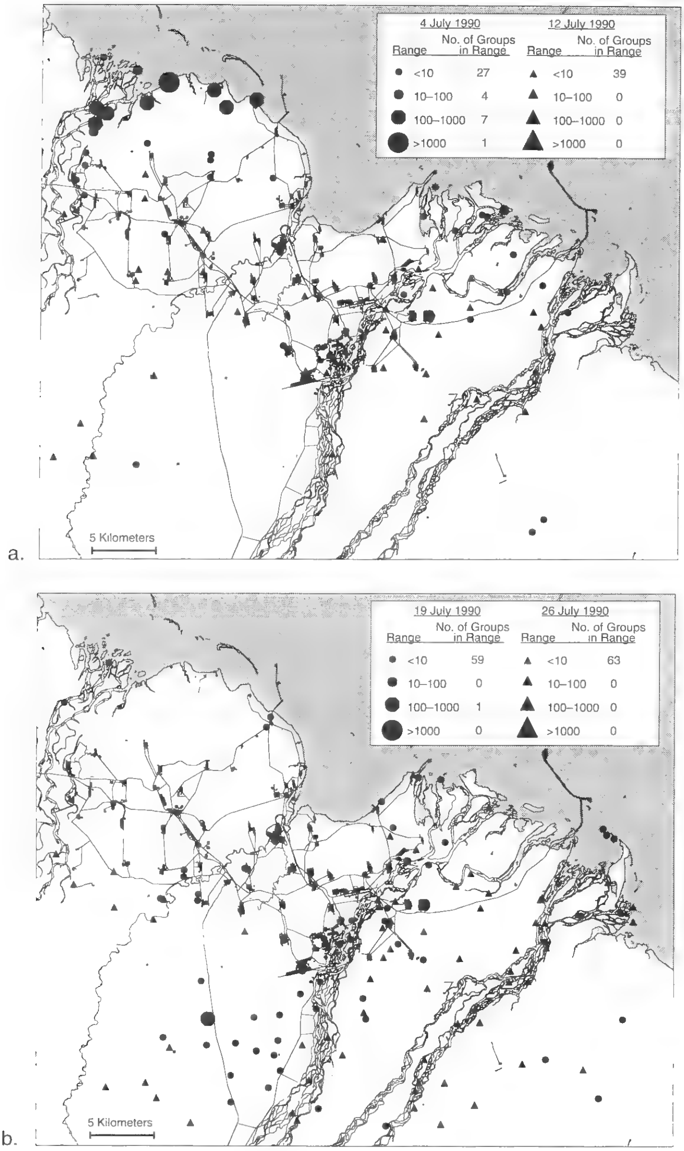



FIGURE 2 *a-b*. Distribution of Caribou observed in the study area during five aerial surveys conducted during 4 July – 1 August 1990. Solid lines are roads or pipelines and rectangles are gravel pads which support oil field facilities.

observers and pilot flying at 130 km/h and 90 m above ground level. Each survey consisted of flights along 29 systematically spaced, fixed-width strip transects (Caughley 1977). Transects were oriented north-south and centered on longitudinal section and township lines mapped on 1:63 360-scale U.S. Geological Survey (USGS) topographic maps. Survey transects were 1.6 km wide and spaced 1.6 km apart. During surveys, each observer was responsible for searching an 800 m-wide swath on one side of the transect centerline. Aluminum rods attached to the aircraft wing struts enabled visual control of transect strip-width. Surveys were conducted between 0800-1700 Alaska Daylight Time.

During surveys, when Caribou were sighted, we slowed the survey aircraft, circled each group, and estimated total number and sex/age classes (i.e., bulls, cows, calves, yearlings, and unclassified

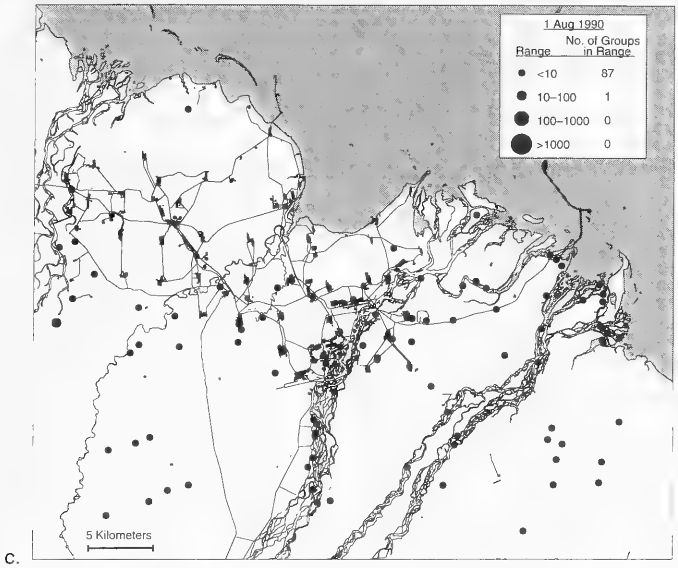



FIGURE 2 *c*. See caption on facing page.

adults). Data were entered into a laptop computer linked to the GPS receiver in the airplane. Locations of Caribou groups were determined by using GPS coordinates recorded on the transect line corrected with the visual estimation of their distances from the transect line. Caribou data were combined with digital base-map data in MapInfo® (MapInfo Corp., 200 Broadway, Troy, New York 12180) and mapped for each survey. For mapping purposes Caribou group size was categorized into four size classes: < 10, 10-100, 101-1000, and > 1000 individuals.

During 1992 and 1993, we systematically monitored weather patterns and insect activity on a daily basis (Pollard et al. 1996). Weather variables were measured using automated weather stations and hand-held instruments (Pollard et al. 1996). Insect abundance was measured using sweep nets, insect traps, and ground observations of Caribou. Insect activity during 1990 and 1991 was subjectively estimated based on ground observation before and after surveys, and by interviews with field technicians located on the ground during aerial surveys. We classified relative insect activity as relatively low, moderate, or high. Insect activity was not measured during 1994.

## Results

Distribution and abundance of Caribou within the study area was highly variable within and among years (Table 1). Numbers of Caribou observed on any survey ranged from 34 to 13 058. Movement of Caribou through the oil field appeared to be directly related to insect activity. In general, when insect activity was low, most Caribou moved inland away from the coast and insect-relief habitat within the oil field. However, when insect activity was moderate or high, Caribou either were present within or were moving through the oil field to reach insect-relief habitats along the coast or on sandbars within major river systems (Table 1, Figures 2-6). When Caribou moved through or were present within the oil field, it was necessary for them to cross pipelines, roads, and associated infrastructure. We describe Caribou distribution and abundance for each year of study below. More detailed descriptions of each survey are given in unpublished reports available from the authors (Pollard et al. 1992*a**, *b**; Pollard and Ballard 1993*; Pollard and Noel 1994*, 1995*).

*1990.* — The 4-5 July survey revealed large groups of Caribou in the coastal region of Simpson Lagoon and the Kuparuk River Delta (Figure 2*a*). These groups comprised most of the 10 867 Caribou in the study area. Insect activity was high during this survey (Table 1). Smaller groups were distributed throughout the central portion of the PBOF within 18 km of the coast. On 12 July, insect activity was low and the coastal aggregations of Caribou had dispersed (Figure 2a). Most Caribou had left the study area and only 82 individuals were observed in small groups spread throughout the PBOF.

On 19 July, insect activity was again low and most Caribou were in small groups distributed along 30 km between the west channel of the Sagavanirktok River and the Putuligayuk River, and within the PBOF (Figure 2*b*). One large group of 400 individuals was observed near the Trans-Alaska Pipeline, about 11 km south of the central portion of the PBOF.

On 26 July, insect activity was still low and 109 individuals were distributed in small groups along the

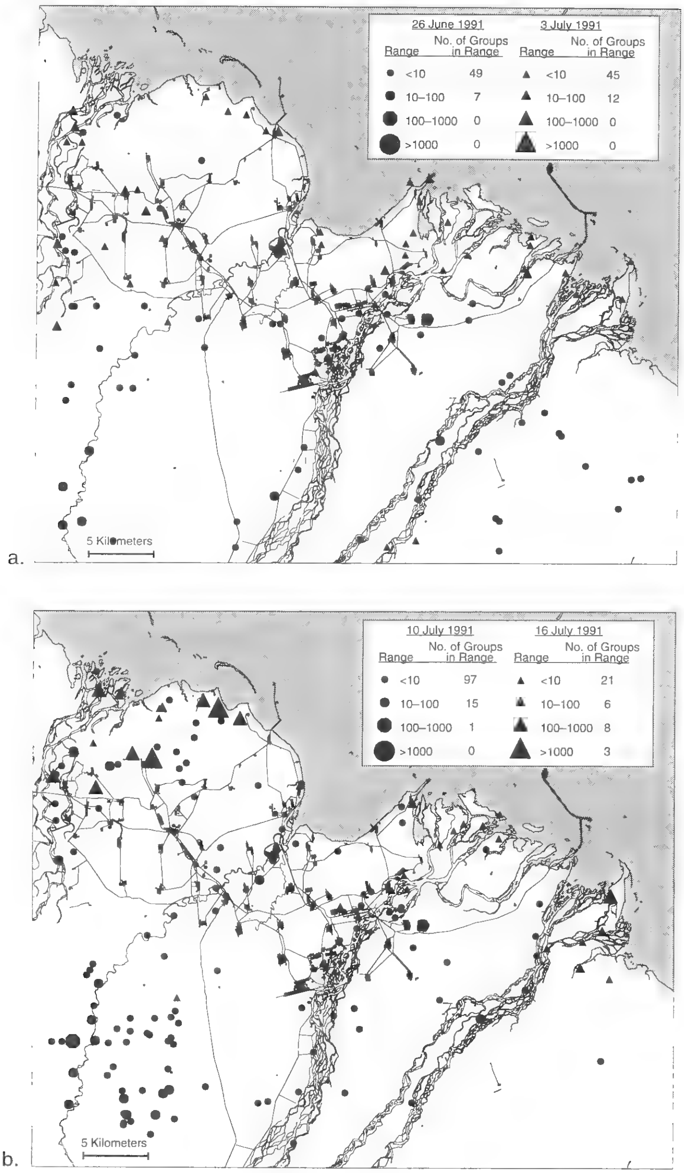



FIGURE 3 *a-b*. Distribution of Caribou observed in the study area during six aerial surveys conducted during 26 June–31 July 1991. Solid lines are roads or pipelines and rectangles are gravel pads which support oil field facilities.

Sagavanirktok River and along the southern limit of the study area (Figure 2*b*). Some of these groups were close to roads and infrastructure. The 1 August survey was also during low insect activity and revealed small groups of Caribou scattered along the southern portion of the study area and throughout the PBOF (Figure 2*c*).

*1991*. — During the 26 June survey, insect activity was low and a total of 267 Caribou were observed along the Kuparuk, Putuligayuk, and Sagavanirktok river channels and in the PBOF (Figure 3*a*). Twelve small groups were observed southeast of the eastern channel of the Sagavanirktok River. On 3 July, insect activity was classified as low to moderate and 370 individuals were observed within 16-18 km of the coast. Small groups were found across the study area, including areas along the Sagavanirktok and Kuparuk rivers and in the PBOF (Figure 3*a*).

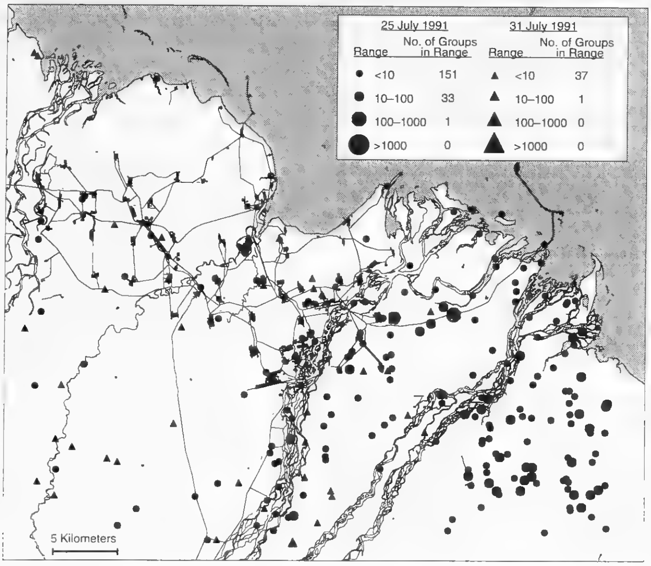
c.



FIGURE 3 *c*. See caption on facing page.

Over twice as many Caribou ($n$ = 781) were observed during the 10 July survey as on 3 July, although insect activity was again low (Table 1). Small groups were scattered throughout the study area, including the PBOF, and there was a large concentration inland, south of the PBOF and west of the Trans-Alaska Pipeline (Figure 3*b*). Relatively high winds and low temperatures suppressed insect activity on 10 July (Pollard et al. 1996).

The 16 July survey indicated a large influx of Caribou into the study area as we observed 7079 individuals (Table 1). Most were located along the Kuparuk River and near the coast in the western portion of the PBOF (Figure 3b). Smaller groups were observed along the coast in the Sagavanirktok River Delta. Mosquitoes were moderately active during the early part of the day, but activity diminished in the afternoon as winds increased (Pollard et al. 1996). Ground-based observations conducted at 1700 hours, after the aerial survey, revealed that many of the large groups observed during the aerial survey had combined and were moving south through the center of the oil field. A group of approximately 4000 Caribou moved clockwise through the entire PBOF and was observed finally on the floodplain of the Kuparuk River. To make these movements, this group crossed at least six roads and ten pipelines.

On 25 July, with low insect activity, there were 1465 Caribou in the study area. Most were distributed east of the west channel of the Sagavanirktok River, and there were small groups in the PBOF (Figure 3*c*). The 31 July survey, also with low insect activity, indicated that even fewer Caribou were in the study area; only 132 Caribou were sighted. Most of these individuals were inland in the southwestern portion of the study area, with some small groups in the PBOF (Figure 3*c*).

*1992*. — During the aerial survey on 9 July, 10 331 Caribou were observed in the study area (Table 1). Mosquito activity was high on this date. An influx of Caribou from the west resulted in high concentrations in coastal areas between the Kuparuk River and the western shore of Prudhoe Bay (Figure 4*a*). Ground observations conducted on the evening of 9 July, after the aerial survey, suggested that mosquito activity had decreased and several large groups had combined and traveled south through the oil field. This is the same pattern observed on 16 July 1991 with moderate mosquito activity. By 2200 hours on 9 July, a group of approximately 4000 Caribou was observed bedded down in the central portion of the oil field.

On 10 July, 13 058 Caribou were observed in the study area. Mixed-sex Caribou groups were widely distributed across the oil field (Figure 4a). Approximately 3000 Caribou were observed on gravel drilling pads and roads, probably seeking relief from mosquitoes which were moderately active. We observed several groups from the ground which encountered roads with high levels of vehicular traffic. The animals were delayed in crossing until traffic subsided, and then crossed or walked along the roads.

The 13-14 July survey was completed over a two-day period due to mechanical problems with the aircraft. Only 147 Caribou were observed in the

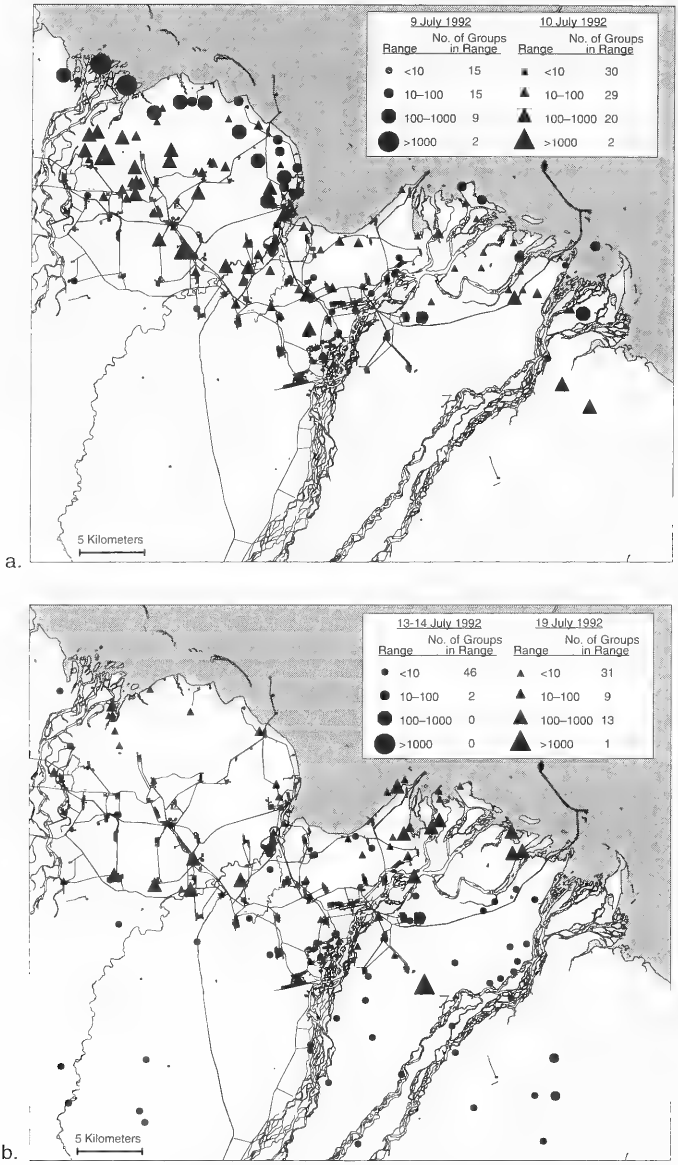



FIGURE 4 *a-b*. Distribution of Caribou observed in the study area during eight aerial surveys conducted during 9 July–31 July 1992. Solid lines are roads or pipelines and rectangles are gravel pads which support oil field facilities.

study area during the survey, most of which were in small groups south of the PBOF near the Sagavanirktok River (Figure 4*b*) and scattered throughout the PBOF. Insect activity was low during this survey.

During the 19 July survey, 7644 Caribou were observed in the study area (Table 1). Observations from this survey, and ground-based observations conducted during 20-22 July, indicated large groups of Caribou moved through the PBOF on these dates. Insect activity (mosquitoes and oestrid flies) was moderate to high on 19-22 July. Many Caribou were on gravel roads and pads, or in the shade of buildings and pipelines. These Caribou displayed signs of insect harassment (e.g., shaking their heads, bodies, and twitching their tails, and kicking) (Pruitt 1960; Espmark 1968; Kelsall 1968; Skoog 1968; Curatolo 1975; Dau 1986). Caribou remained on the gravel

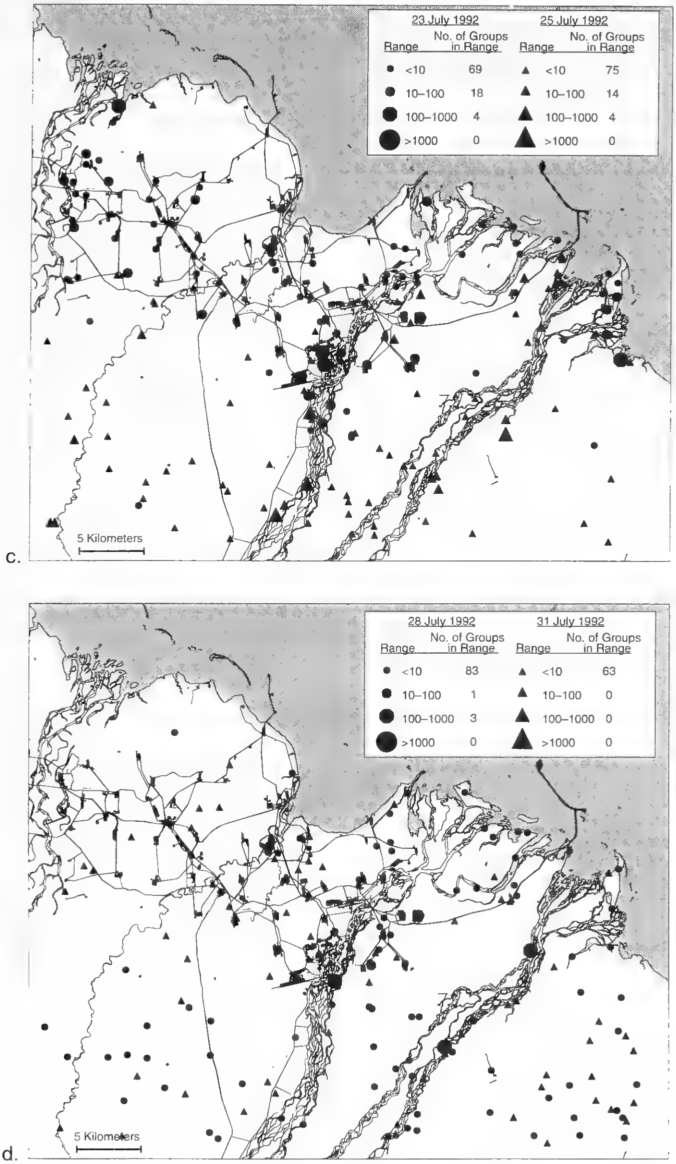
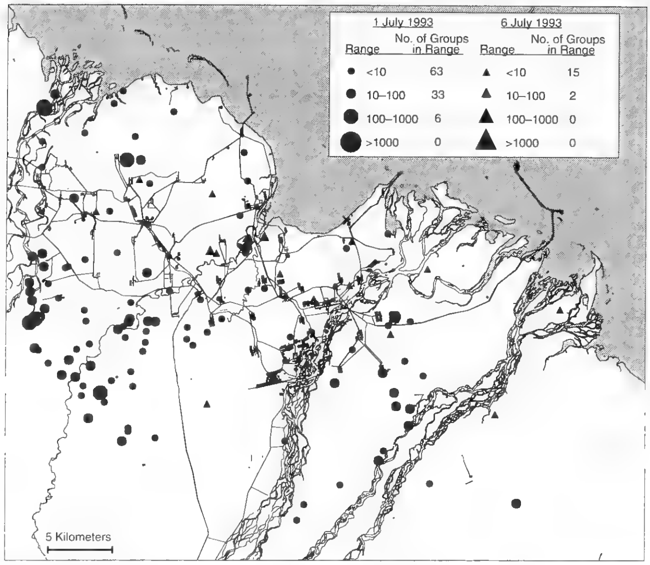



FIGURE 4 *c-d*. See caption on facing page.

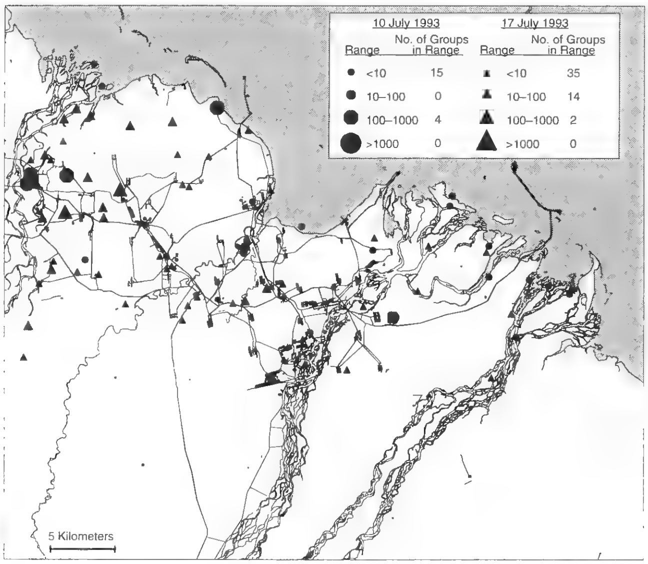
structures from several minutes to >2 hours. Many large Caribou groups were observed in the Sagavanirktok River delta, or on barren mud flats and gravel river bars, probably seeking insect relief from coastal winds (Figure 4b). Several groups of 100-1000 animals were in the center of the PBOF.

On 23 July, 1936 Caribou were observed in the study area (Table 1). Mosquito abundance was low, but oestrid activity remained high. Approximately 27% of the Caribou observed were on gravel pads, roads, or under buildings seeking relief from insects. The highest concentrations of Caribou occurred in the Kuparuk and Sagavanirktok river channels and deltas (Figure 4c). Many small groups were scattered throughout the PBOF.

A total of 2503 Caribou were observed on 25 July within the study area (Table 1). A majority were in large groups on gravel bars in the Sagavanirktok River. Many smaller groups were widely distributed across the southern half of the study area. Cooler temperatures, fog, and moderate winds from the northeast suppressed mosquito




a.



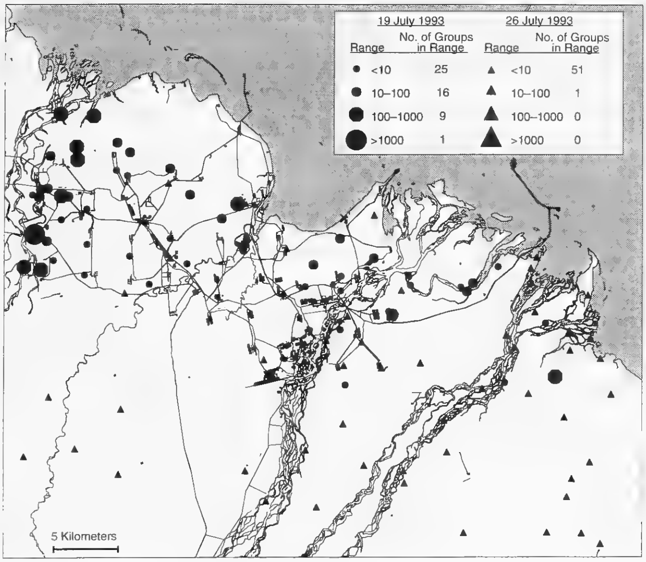

b.

FIGURE 5 *a-c*. Distribution of Caribou observed in the study area during six aerial surveys conducted during 1 July – 26 July 1993. Solid lines are roads or pipelines and rectangles are gravel pads which support oil field facilities

activity but not oestrid fly activity on this day (Pollard et al. 1996).

During the 28 July survey, 593 Caribou were observed in the study area (Table 1). The majority were located in small groups in the southern half of the study area. There were a few large groups along the Sagavanirktok River (Figure 4*d*). A similar distribution was observed on 31 July for 147 Caribou, except several small groups were in the PBOF (Figure 4*d*). Insect activity was moderate on 28 July and low on 31 July, and many Caribou exhibited behavior characteristic of animals experiencing oestrid fly harassment.

*1993.* — During the 1 July survey, insect activity was low, and 2242 Caribou were observed (Table 1).




c.

FIGURE 5 *c*. See caption on facing page.

The majority of these were in the western portion of the study area (Figure 5*a*). Most of the larger groups were along the Kuparuk River. Many moderately sized groups were observed in the drainages of the Kuparuk, Putuligayuk, and Sagavanirktok rivers and in the PBOF (Figure 5*a*). We observed only 75 Caribou on the 6 July survey. Most of these animals were in small groups widely dispersed in the central portion of the PBOF (Figure 5*a*). Few mosquitoes were active on either 1 July or 6 July (Pollard et al. 1996).

On 10 July, insect activity was high, and 3088 Caribou were observed. The majority of Caribou were in four large groups, three of which were in or adjacent to the Kuparuk River (Figure 5*b*). The fourth large group was located on the coast in the northwest portion of the study area. There were a few small groups in the PBOF.

On 17 July, 1163 Caribou were observed (Table 1). The majority were scattered across the northern half of the study area, primarily in the northwest portion. Most Caribou occurred in small groups, several of which were observed on gravel pads and roads in the PBOF. The two largest groups (140 and 300 animals) were moving northeast through the PBOF. Observations of Caribou behavior and quantitative measures of insect abundance suggested that oestrid flies were moderately active and mosquito activity was low (Pollard et al. 1996).

The number of Caribou ($n$ =3797) observed on 19 July had more than tripled since 17 July, probably as a result of an influx of Caribou from the Kuparuk oil field to the west, as insect activity increased over those two days. As on 17 July, the majority of Caribou were located in the northwest section of the study area (Figure 5*c*). Sixty-two percent of the animals were in four large groups that were moving north along the Kuparuk River. Other groups of 10-1000 were scattered throughout the PBOF. Oestrid fly activity was high on 19 July, but mosquito activity was low. On 26 July, only 96 Caribou were observed (Table 1). These animals were widely scattered across the study area in small groups primarily south of the PBOF (Figure 5*c*). Insect activity was low on 26 July.

*1994.* — During the 5 July survey, 276 Caribou were observed (Table 1, Figure 6*a*). Sixty-two percent of the animals were located in the northwest section of the study area. The remainder were in small groups scattered throughout the PBOF and near the Sagavanirktok River. On 11 July, we observed the largest number of Caribou (i.e., 2599) for any survey of 1994. Ninety-four percent of the Caribou were within four groups. Three of these groups were in the south and west side of the PBOF, and one was on the coast near the mouth of the Kuparuk River.

Relatively small numbers of Caribou occurred in the study area on 19 and 26 July (Figure 6*b*). On the 31 July survey, 1217 Caribou were observed in the study area (Table 1). Caribou were widely-scattered across the study area, including the PBOF. Eighty-two percent of the Caribou were located in the southwest corner of the study area (Figure 6*c*). In the 7-8 August survey, only 79 Caribou were observed widely scattered throughout the PBOF.

## Discussion

It was suggested that large post-calving aggregations stopped moving through the PBOF as a

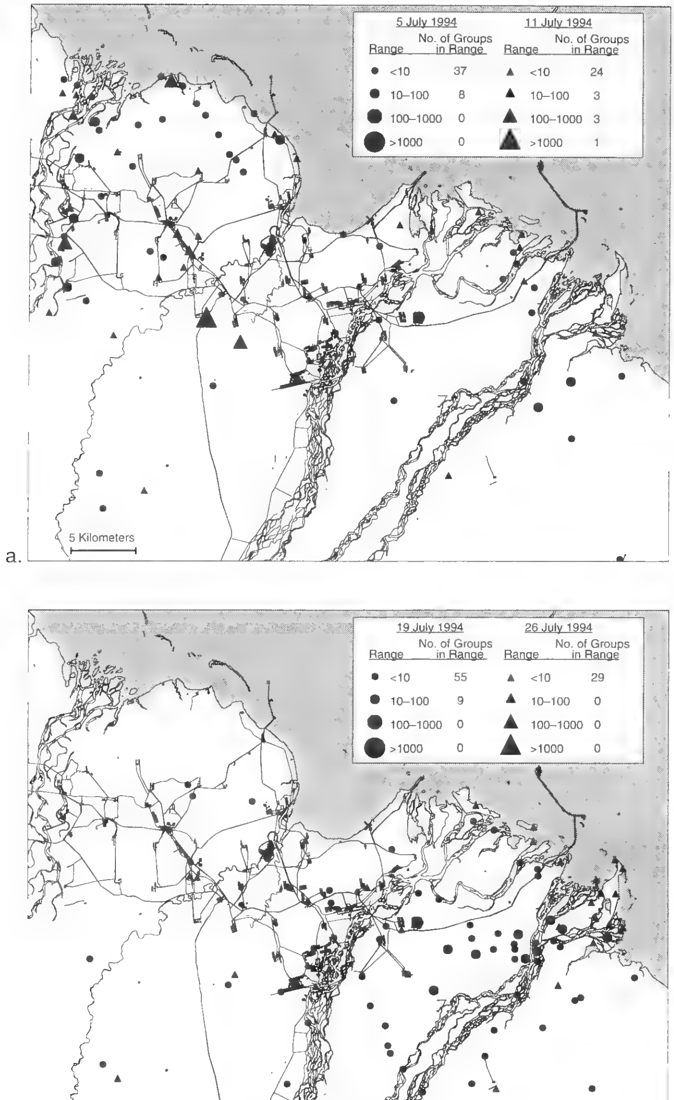
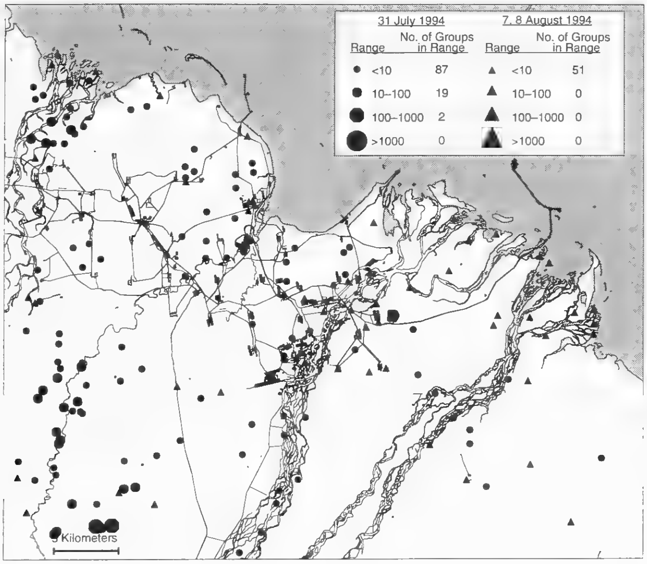



FIGURE 6 *a-b*. Distribution of Caribou observed in the study area during six aerial surveys conducted during 5 July – 8 August 1994. Solid lines are roads or pipelines and rectangles are gravel pads which support oil field facilities.

result of oil field development (Whitten and Cameron 1985; Johnson and Lawhead 1989*). However, from 1975-1989, post-calving surveys of the PBOF were limited in intensity and number (Cameron and Whitten 1976*; Whitten and Cameron 1983*b*; Cameron et al. 1986; Carruthers and Jakimchuk 1986; Carruthers et al. 1987). Because Caribou frequently move into and out of the PBOF in response to changing environmental conditions, infrequent, non-systematic, and/or low-intensity aerial surveys may be of limited value for examining Caribou distribution in relation to oil field infrastructure. Perhaps, more importantly, the relatively small numbers of Caribou observed in the PBOF in the mid-1970s to mid-1980s (Whitten and Cameron 1985; Lawhead 1988; Johnson and Lawhead 1989*), and the large numbers we observed in the 1990s (Table 1), may be related to




c.

FIGURE 6 *c*. See captions on facing page.

the increasing number of Caribou within the CAH. The CAH grew from 5000 to 23 000 animals between 1975 and 1992 (Whitten and Cameron 1983*b*; Valkenburg 1992*; Cameron 1993). It is also possible that Caribou have habituated to the oil fields over the last two decades. There is no hunting or deliberate harassment of animals in the PBOF, so this is a likely possibility.

Weather conditions are generally cooler and windier, and there is less vegetation near the Beaufort Sea coast than inland in the PBOF area (Dau 1986; Linkswiler and Curatolo 1984*; White et al. 1975). These factors are probably responsible for fewer mosquitoes on the coast than inland. Caribou often use the coast as mosquito-relief habitat on warm days, and move inland with cooler evening temperatures (Roby 1978). This occurred on 16 July 1991 and 9 July 1992. Caribou are not always on the coast when mosquitoes are active, however. On 10 July 1992, mosquito activity was moderate, and few Caribou were on the coast. Most Caribou were widely distributed across the PBOF, and about 3000 were on gravel pads and roads, probably seeking relief from mosquitoes. Lawhead and Curatolo (1984*) suggested that, under moderate levels of insect harassment, Caribou will move only as far toward the coast as needed to reach ameliorating temperatures or wind. In the Kuparuk oil field to the west of the PBOF, Dau (1986) suggested forage was of higher quality inland compared to that near the coast, and that Caribou sought such forage after expending large amounts of energy avoiding insects.

When only oestrid flies are present (from late July through mid-August), coastal areas apparently offer limited relief to Caribou (Lawhead and Smith 1990*). Unvegetated sites, such as gravel bars and mud flats, and elevated sites, such as pingos and sand dunes, are used as oestrid fly-relief habitat (White et al. 1975; Fancy 1983; Kuropat and Curatolo 1983*; Murphy and Curatolo 1987; Pollard et al. 1996). We observed Caribou using oil field gravel pads and roads as well as gravel bars in the Sagavanirktok and Kuparuk rivers when oestrid flies were active. The influence of oestrid flies can override any tendency to avoid oil field structures or activities (White et al. 1975; Curatolo et al. 1982*; Dau 1986; Murphy and Curatolo 1987). Indeed, gravel pads and roads appear to provide insect-relief habitat similar to sparsely vegetated gravel bars (Murphy and Curatolo 1987; Pollard et al. 1996). Caribou often are observed lying, standing, or traveling on gravel pads and roads or in the shade of buildings and pipelines (Roby 1978; Fancy 1983; Murphy and Curatolo 1987; Johnson and Lawhead 1989; Pollard and Noel 1994*). During our survey on 19 July 1992, 2400 of the 7644 Caribou observed were on gravel pads and roads in the PBOF, and the rest were on mud flats and gravel bars in river deltas.

Bergerud et al. (1984: 7) examined the impacts of human disturbances on Caribou and concluded that, "Caribou apparently have a high degree of resilience to human disturbance, and seasonal movement patterns and extent of range occupancy appear to be a function of population size rather than of extrinsic disturbance." Our study of post-calving use of the PBOF from 1990-1994 also indicates that Caribou distribution and movements are influenced by weather and insects more than human disturbance.

Our observations are similar to those reported 20 years ago, prior to extensive oil field development. White et al. (1975) found that insect-harassed Caribou moved into the Prudhoe Bay area, across the Kuparuk River Delta, or down the drainages of the Sagavanirktok River to gain access to coastal insect relief habitat. When insect levels diminished, Caribou dispersed inland, moving in a southwesterly direction through the area now occupied by the PBOF.

Recently, Cameron et al. (1995) examined the distribution and movements of 6 to 40 radio-collared Caribou annually during 1980-1993 in relation to a quadrant surrounding the PBOF complex. They relocated each Caribou at least once during the period 25 June through 10 August. They concluded that few Caribou were in the general area of the PBOF complex. Our data suggest that Caribou distribution and use of the PBOF area may be high or low, and is highly variable and can change within hours. Our periodic daily surveys may even have under-represented the occurrence of Caribou in the PBOF. Daily surveys and/or relocation of radio-collared Caribou every 3 to 4 hours would better document the use of the PBOF by Caribou.

Our observations show that Caribou can and do traverse oil field areas during periods of insect harassment. Others have also shown that Caribou cross under elevated pipelines and over roads to access insect-relief habitat (Curatolo and Murphy 1986; Lawhead 1988). Roads, pipelines, and human activity may block, delay, or deflect Caribou as they move through the PBOF, but movements of large groups do occur.

In summary, our observations show the use of, and movement through, the PBOF and surrounding area by Caribou in small and large groups. Caribou occurrence is variable, and depends on weather and insect conditions.

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# Tree Species Composition, Structure, and Carbon Storage in Stands of Urban Forest of Varying Character in Halifax, Nova Scotia

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Characteristics of stands of urban forest in Halifax, Nova Scotia, were analyzed with regards to tree-species composition and carbon sequestration. Older stands in residential and institutional neighbourhoods are dominated by non-native species of trees, thus limiting their usefulness in terms of protection of indigenous biodiversity values. These stands do, however, provide substantial ecosystem service in terms of carbon storage, because they are dominated by relatively large trees with an almost closed canopy (averaging 83% cover), and supporting a relatively large stand biomass (averaging 131 t/ha of above-ground tree biomass). In comparison, younger residential neighbourhoods have larger frequencies of native tree species, reflecting a recent trend to preserving some natural forest as buffer strips between properties. However, the proportion of native species of trees in the younger neighbourhoods is expected to decrease with time, because non-indigenous species are the strongly dominant choice among recent plantings by homeowners. Because of recent disturbance, urban forest in younger neighbourhoods has a relatively small biomass, but this should increase with succession. Natural-forest urban parks have a tree-species composition and stand structure that are similar to that of more remote, natural forests.

Key Words: urban forests, tree species, structure, carbon storage, Halifax, Nova Scotia.

Urban forests consist of trees growing in areas where the dominant land use is urban or suburban, that is, in the vicinity of homes and commercial, institutional, and industrial buildings. Urban forests are important because they provide many important environmental benefits, the most notable of which are the following: (1) provision of habitat for urban wildlife, including some elements of indigenous biodiversity, (2) improvement of urban aesthetics, (3) provision of out-of-doors shade and ameliorated microclimates, (4) energy savings through smaller demands for seasonal cooling and heating of the interior of buildings (trees cool buildings by providing shade, and decrease heating costs by reducing wind speeds near buildings, thereby diminishing air-infiltration rates), (5) reduction of air pollution through direct uptake and physical filtering of gases and particulates, coupled with smaller emissions of pollutants associated with smaller energy demands for heating and cooling buildings, and (6) fixation of atmospheric carbon dioxide in the aggrading biomass of trees (Heisler 1986; Rowntree and Nowak 1991; McPherson 1994; Nowak 1994b; Nowak et al. 1994; Freedman and Keith 1995).

Urban forests can develop from trees and stands that remain when a forested area is converted to residential use, or they may develop from saplings planted after homes or other buildings are constructed, or from plants that self-seed into the habitat. If the trees are planted, the species are commonly non-indigenous to the local region, and even to the continent. Because of the non-indigenous nature of many of their species of trees, urban forests commonly support markedly different biodiversity values than the more-natural forests that may occur as remnants within the urban environment, or more extensively in the surrounding area.

The fixation of atmospheric $CO_2$ in urban forests is significant in view of the well-documented, increasing concentrations of this gas, from about 280 ppm in the mid-1800s to 355 ppm in 1995, with further increases projected into the future (Wigley and Raper 1992; Boden et al. 1993; Freedman 1995a). The increased concentrations of $CO_2$ and other radiatively active gases (or RAGs; notably methane, nitrous oxide, ozone, and chlorofluorocarbons) have resulted from emissions associated with human activities, and may cause an intensification of Earth's greenhouse effect (Marland and Rotty 1985; Ramanathan 1988; Anonymous 1995; Freedman 1995a). At least one-half of the potential enhancement of the greenhouse effect is estimated to be associated with increased concentrations of $CO_2$ (Schneider 1989; Lashof and Ahuja 1990; Rodhe 1990; Bolin 1991). This environmental change could cause an increase in Earth's average surface temperature and other climatic changes, potentially resulting in ecological disruptions of great consequence to natural biodiversity and to human socio-economic systems (Bolin et al. 1986; Schneider 1989a,b; Houghton et al. 1990; Wetherald 1991; Bolin 1991; Rosenzweig and Parry 1994; Freedman 1995a).

One action that would contribute to mitigation of this potential problem is to offset some emissions of RAGs by increasing the rate of fixation and storage of atmospheric $CO_2$ by vegetation. The most sensible

option towards $CO_2$-carbon sequestration is to increase the amount of organic-carbon stored in the biomass of trees, in both rural and urban forests (Marland 1988; Sedjo 1989a,b; Houghton 1990, 1991; Moulton and Richards 1990; Nagle 1990; Freedman et al. 1992; Nabuurs and Mohren 1993; Trexler and Haugen 1995; Freedman and Keith 1995). In addition to being a potential source of $CO_2$-offset credits through fixation of this gas in their accumulating biomass, urban trees help to reduce $CO_2$ emissions by decreasing energy requirements to cool and heat buildings (Nowak 1993).

The purpose of the present study is twofold: (1) to examine variations of tree-species composition in an urban forest, and to interpret the patterns in terms of indigenous biodiversity values, and (2) to contribute to the information base required for evaluation of the potential role of urban trees in carbon sequestration. To these ends, this study has assessed the species composition of trees, stand structure, and quantities of carbon stored in trees in neighbourhoods of various character in the City of Halifax, Nova Scotia, including areas in which the predominant land-use is residential, institutional, or park.

## Methods

1. *Study Area*

The City of Halifax is located on the Atlantic Coast of Nova Scotia, Canada, at about 44°39'N and 63°37'W. Halifax is the largest city in Atlantic Canada, with a population of about 114-thousand in its 79 km$^2$ area, and 296-thousand in its 2.5-thousand km$^2$ metropolitan area, which includes Dartmouth, Bedford, Sackville, and built-up areas of Halifax County (McCann 1988). The local economy is heavily dependent on government services, financial institutions, the armed forces, the transportation industry, universities, and other regional services — there is relatively little manufacturing, fishing, or other primary industrial activities (McCann 1988).

Halifax has a temperate maritime climatic regime, with a mean annual precipitation of 137 cm/yr, of which 86% arrives as rain and the remainder as snow (Anonymous 1993). The mean annual temperature is 6.5°C, mean daily temperature is 13.7°C during the growing season of May to October, and there are 4254 degree-days above 18°C each year (Anonymous 1993).

Soils in the City of Halifax are primarily shaly loams developed from surficial tills of Precambrian slates, with some bedrock exposures, generally good drainage, and a rolling topography (MacDougall et al. 1963). The area is in the East Atlantic Shore section of the Acadian Forest region, in which the typically dominant natural vegetation is forest dominated by Black Spruce (*Picea mariana*), White Spruce (*P. glauca*), and Balsam Fir (*Abies balsamea*). Red Maple (*Acer rubrum*), white and Yellow Birches (*Betula papyrifera* and *B. lutea*), Red Spruce (*Picea rubens*), and White Pine (*Pinus strobus*) are less prominent, although they can be locally abundant within this forest section (Rowe 1972). Within the City of Halifax, however, most of the natural forest has been cleared and converted into urban land-uses, including an urban forest dominated by non-indigenous species of trees.

2. *Study Sites*

Residential neighbourhoods in Halifax represent a continuum of ages and housing types. For the purposes of this study, representative study areas were chosen to illustrate the following classes of land-use:

(1) *Residential areas with homes less than 8 years old.* There were three sampling sites in this category, located in a neighbourhood known as Clayton Park, where urbanization is relatively recent. The sample sites were named Warwick (sampled as a 1.3-ha plot), Turnmill (0.89 ha), and Canterbury (1.0 ha). The homes in Warwick and Turnmill were less than two years old, while those in Canterbury were less than eight years old.

(2) *Residential areas with homes 40-50 years old.* The three sampling sites were located in a neighbourhood known as Fairview. The sample sites were named Central (2.4 ha), Coronation (2.2 ha), and Birch (0.71 ha), and all contained homes that were 40-50 years old.

(3) *Residential areas with homes older than 70 years.* There were three sampling sites, located in a neighbourhood known as the South End. The sample sites were named South (1.1 ha), Chestnut (0.51 ha), and Cedar (0.82 ha), and had homes that were 70 or more years old.

(4) *Institutional.* The three sampled sites consisted of a hospital complex and two universities, with their associated lands. The sample sites were parts of the campuses of Dalhousie University (8.2 ha), Saint Mary's University (4.2 ha), and an area containing the Killam Children's Hospital (2.3 ha).

(5) *Natural-area urban parks.* Two natural-forest, urban parks were sampled: Fleming Park (45 ha) and Point Pleasant Park (75 ha). Both of these have second-growth, conifer-dominated forests that are essentially natural in character, although there has been some removal of dead trees, particularly in Point Pleasant Park.

In addition, data on tree-species composition were obtained for the Public Gardens, a horticultural urban park managed in the Victorian style (Stewart and Harvey 1982), and for several boulevards which are essentially managed as horticultural strips.

3. *Measurement of Trees*

The fieldwork for this study was conducted during the growing season of 1995. All trees within the resi-

dential and institutional sites were sampled (with permission of landowners, where private property was involved), including boulevard trees. All trees with a diameter (at breast height; DBH) greater than 5.0 cm were identified, and the DBH was measured. Because of the large areas of Point Pleasant and Fleming Parks, these were each sub-sampled using eight, widely spaced plots of 20m × 20m. The field data were used to compute standard descriptors of forests, including basal area and density.

The canopy areas of the entire plots were estimated using aerial photographs with a scale of $1{:}10^4$. A grid of 2cm × 2cm was mounted over the airphoto, and the numbers of intersections of grid points with the tree canopy was recorded, and converted to percent cover.

4. *Calculations of Tree Biomass and Carbon Storage*

The above-ground biomass of trees was estimated using published regressions of DBH versus dry weight (Ker 1980; Freedman et al. 1982; Freedman 1984). Species-specific equations were used where available, as follows: *Abies balsamea*, *Acer rubrum*, *A. saccharum*, *Betula lutea*, *B. papyrifera*, *Picea glauca*, *P. mariana*, *P. rubens*, *Populus tremuloides*, and *P. grandidentata* (Freedman et al. 1984), and *Fagus grandifolia*, *Larix laricina*, *Pinus banksiana*, *P. resinosa*, *P. strobus*, and *Tsuga canadensis* (Ker 1980). For other species, biomass was estimated using generic equations for coniferous or angiosperm trees (Freedman 1984). Carbon content was estimated to be one-half of dry weight (Nowak 1994b).

## Results and Discussion

1. *Species Composition*

Species composition of the stands of urban forest in Halifax varied tremendously, from a relatively natural mixture of native species in Point Pleasant and Fleming Parks, to a more species-rich assemblage of non-indigenous species in areas managed for horticultural purposes, such as the Public Gardens. The frequency of non-native species of trees was small in the natural-area parks, but much greater in other stands of urban forest, particularly in the oldest stands, such as the South End and the three sampled lengths of boulevard (Table 1).

The most species-rich stand of urban forest is the Public Gardens, which is managed to include a diverse assemblage of horticultural plants, and contained 74 species of trees within an area of 4 ha. However, three non-indigenous species comprised 46.7% of the 604 trees in the Public Gardens: Linden (*Tilia × europaea*) 20.0%, Scotch Elm (*Ulmus glabra*) 20.0%, and Norway Maple (*Acer platanoides*) 6.7%. Of the 604 trees in the Public Gardens, 91% are non-indigenous to North America, and only 3.6% are native to Nova Scotia.

TABLE 1. Frequency of species of trees non-native to North America in various neighbourhoods in the city of Halifax. The data for the residential areas are each weighted averages of three sample plots, with the cumulative area indicated in parentheses. All trees in the horticultural park were surveyed, but the natural-area parks were each sub-sampled using eight quadrats of 0.04 ha.

| Neighbourhood | Age (years) | Percent of trees non-native | Number of trees sampled |
|---|---|---|---|
| 1. Residential Neighbourhoods | | | |
| Clayton Park (3.2 ha) | 0-8 | 8% | 791 |
| Fairview (5.3 ha) | 40-50 | 25 | 447 |
| South End (2.4 ha) | 70-80 | 72 | 187 |
| 2. Boulevard Strips | | | |
| Boulevard 1 (3.0 km) | >70 | 93 | 511 |
| Boulevard 2 (3.0 km) | >70 | 78 | 279 |
| Boulevard 3 (5.5 km) | >70 | 67 | 560 |
| 3. Horticultural Park | | | |
| Public Gardens (4 ha) | mature | 91 | 604 |
| 4. Natural-area Urban Park | | | |
| Point Pleasant (75 ha) | mature | 0.2 | 476 |
| Fleming (45 ha) | mature | 0.0 | 382 |

Among the three residential neighbourhoods, the relatively older South End had the greatest frequency of non-indigenous species, which accounted for 72% of the tree density. Among the 29 species of trees in the total sampled area of 2.4 ha, the most frequent were: Norway Maple (32.5% of density), American Elm (*Ulmus americana*; 12.6%), Linden (10.4%), and European Ash (*Fraxinus excelsior*; 7.4%). The intermediate-aged Fairview plots had 49 species in the sampled area of 5.3 ha, with 25% of the tree density comprised of non-indigenous species. The most frequent species were Red Maple (34.4%), White Birch (11.5%), Norway Maple (5.6%), and European Mountain Ash (*Sorbus aucuparia*; 5.5%). The most-recently developed neighbourhood, Clayton Park, had 37 species in the 3.2 ha sampled area, with 8% of the density being non-indigenous species. The most frequent species were Red Maple (24.4%), Red Spruce (21.2%), Balsam Fir (14.9%), and White Birch (11.1%).

The relatively large proportion of native species in the most-recently developed residential neighbourhood (Clayton Park) results from the survival of many trees from the natural forest that previously occupied that area. In part, this results from relatively large lot sizes in these newly developed subdivisions, coupled with the relatively "natural" approach taken in much of the landscaping. This was intended to preserve many of the existing trees, thereby decreasing the costs of site preparation and post-construction landscaping, while also catering to the

desires of many new homeowners to have a well-treed lot. It is notable, however, that non-native species of trees remain the strongly dominant choice of homeowners in their horticultural plantings in this young neighbourhood, so the frequency of non-indigenous species will likely increase over time in this developing, urban forest.

The 14.7 ha of institutional lands contained 36 species of trees, the most frequent of which were Red Oak (*Quercus rubra*; 12.8%), Red Maple (12.4%), American Elm (11.5%), and Norway Maple (11.5%), a species mixture that complements that found elsewhere in older parts of the city.

Almost all of the species in the natural-area urban parks are native trees, the most frequent of which are Red Spruce (36.0%), Red Maple (19.7%), White Birch (11.0%), and White Pine (9.4%). These are also dominant species in much of the natural forests elsewhere in central Nova Scotia. The overall character of the stands in the natural-area urban parks is of a mature, conifer-dominated mixedwood. This is in marked contrast to the character of the stands in residential and institutional neighbourhoods of Halifax, which are strongly dominated by non-indigenous species of angiosperm trees.

Therefore, except for the natural-area parks, the urban forest of Halifax is dominated by a diverse assemblage of non-indigenous species of trees, representing a miscellany of horticultural selections from far-flung places having a temperate climate. It is typical of cities in North America (and elsewhere) that extensive areas of urban forest contain non-indigenous species of trees, shrubs, and ground vegetation, and are often dominated by these alien species (Whitney and Adams 1980; Dorney et al. 1984; McBride and Froehlich 1984; Miller and Winer 1984; McBride and Jacobs 1986; Nowak 1994a). This fact is symptomatic of a larger element of the global biodiversity crisis — the ever-increasing homogenization of Earth's biotas and ecosystems, characterized by huge increases in the rates by which certain species of plants, animals, and microorganisms are being distributed by humans beyond their natural ranges, either deliberately or accidentally (Bratton 1982; Harty 1986; Drake et al. 1989; Goudie 1990; Freedman 1995a). Introductions associated with horticulture are intended to achieve a culturally desired, out-of-doors aesthetic. This objective is accomplished through the cultivation of a variety of non-native plants which mainstream horticulturalists have come to know and prefer, have therefore become widely available commercially, and are commonly utilized in preference to local species, against which there is often a negative, horticultural bias.

Unfortunately, introductions of some alien species, including trees, can cause many indirect, ecological damages, such as deterioration or elimination of the habitat of native species, accidental releases of pathogens and pests, and sometimes the establishment of self-maintaining populations of species that turn out to be aggressively invasive (Bratton 1982; Harty 1986; White et al. 1993; Freedman 1995b; Ruesink et al. 1995). To the extent that it is dominated by non-native species of trees, the urban forest of Halifax is likely to have limited value in providing habitat for indigenous elements of biodiversity.

In view of this biodiversity-related consideration, it is encouraging that the tree-species composition of the youngest of the studied residential neighbourhoods reflects an emerging trend to preserving boundary-strips of natural forest and individual native trees in new housing developments in Halifax. It is less heartening, however, to note that almost all new plantings in this young neighbourhood are of non-indigenous species, and that native species are exceedingly difficult to purchase in horticultural outlets in the study area (as is common in most of North America). Nevertheless, the retention of some native vegetation in the newest residential neighbourhoods represents a substantial improvement over the fashion of urban-forest management in older areas of Halifax, where virtually all existing trees are of planted, non-indigenous species.

2. *Stand Characteristics*

The three residential neighbourhoods can be considered to represent a chronosequence of stands of increasing age since their conversion from natural forest into a housing-dominated land-use. Broader elements of the successional pattern can be inferred from structural attributes of the urban forests of these neighbourhoods (Table 2). The youngest neighbourhood (Clayton Park, <8 years old), averaged a relatively large density (241 stems/ha) of smaller trees (average DBH range of 10-15 cm among major species), with a small canopy cover (13.9%), and a small above-ground tree biomass (16.9 tonnes/ha). The intermediate-aged neighbourhood (Fairview, 40-50 years old) had a smaller tree density (158 stems/ha) but larger trees (range of average DBH of major species of 13-25 cm), a more extensive canopy cover (31.9%), and a greater stand biomass (18.8 t/ha). The oldest neighbourhood (South End, >70 years old) had the smallest tree density (145 stems/ha), the largest trees (range of average species DBHs of 30-62 cm), a relatively complete canopy cover (82.6%), and the largest stand biomass (131 t/ha) among the residential neighbourhoods that were studied.

The three institutional plots are all located in older areas of the city of Halifax. Although the average tree density (50 stems/ha) and canopy cover (19.9%) were relatively small (because of the large buildings and extensive parking lots on institutional lands), the individual trees are relatively large (average range of

TABLE 2. Characteristics of stands of urban forest in Halifax, Nova Scotia. Data are averages (± standard error), for only the most prominent species of trees.

| Species | Number Sampled | Mean DBH (cm) | Density (no./ha) | Biomass (t/ha) | Carbon (t/ha) |
|---|---|---|---|---|---|
| 1. South End (>70-year-old residential neighbourhood; 3 plots, 2.4 ha) | | | | | |
| *Acer platanoides* | 106 | 31.9 | 45.6 (8.1) | 39.4 (9.0) | 19.7 (4.5) |
| *Ulmus americana* | 41 | 41.6 | 17.2 (1.2) | 28.8 (10.9) | 14.4 (5.4) |
| *Tilia x europaea* | 34 | 42.3 | 14.8 (3.7) | 16.4 (4.2) | 8.2 (2.1) |
| *Fraxinus excelsior* | 24 | 34.7 | 13.0 (9.2) | 13.2 (10.9) | 6.6 (5.5) |
| *Acer rubrum* | 22 | 30.4 | 10.0 (4.4) | 6.7 (3.2) | 3.3 (1.6) |
| *Quercus rubra* | 10 | 62.3 | 5.1 (3.5) | 15.6 (8.5) | 7.8 (4.2) |
| 23 other species | 89 | - | 39.4 | 5.0 | 2.5 |
| TOTAL | 326 | - | 145.1 (39.7) | 131.0 (43.9) | 65.5 (21.9) |
| 2. Fairview (40-50-year-old residential neighbourhood; 3 plots, 5.3 ha) | | | | | |
| *Acer rubrum* | 289 | 18.3 | 47.9 (14.6) | 8.0 (3.6) | 4.0 (1.8) |
| *Betula papyrifera* | 97 | 13.1 | 21.7 (6.1) | 1.6 (0.3) | 0.8 (0.2) |
| *Acer platanoides* | 47 | 24.5 | 15.5 (11.2) | 3.0 (0.9) | 1.5 (0.4) |
| *Sorbus aucuparia* | 46 | 12.8 | 12.7 (7.1) | 0.5 (0.2) | 0.3 (0.1) |
| 45 other species | 361 | - | 60.2 | 5.7 | 2.9 |
| TOTAL | 840 | - | 158.0 (20.7) | 18.9 (5.3) | 9.5 (2.6) |
| 3. Clayton Park (<8-year-old residential neighbourhood; 3 plots, 3.2 ha) | | | | | |
| *Acer rubrum* | 186 | 11.9 | 59.7 (6.4) | 7.1 (0.3) | 3.6 (0.2) |
| *Picea rubens* | 162 | 12.9 | 51.7 (9.3) | 4.6 (1.6) | 2.3 (0.8) |
| *Betula papyrifera* | 85 | 11.0 | 27.7 (10.5) | 1.5 (0.8) | 0.8 (0.4) |
| *Abies balsamea* | 114 | 10.2 | 35.3 (17.9) | 1.2 (0.6) | 0.6 (0.3) |
| *Pinus strobus* | 34 | 14.9 | 10.7 (4.9) | 0.8 (0.3) | 0.4 (0.2) |
| 32 other species | 172 | - | 55.8 | 1.7 | 0.9 |
| TOTAL | 763 | - | 240.9 (31.2) | 16.9 (2.1) | 8.5 (1.1) |
| 4. Institutional Neighbourhoods (3 plots, 14.9 ha) | | | | | |
| *Quercus rubra* | 97 | 30.6 | 4.1 (3.5) | 3.3 (2.3) | 1.7 (1.1) |
| *Acer rubrum* | 94 | 21.7 | 4.6 (2.6) | 1.6 (1.0) | 0.8 (0.5) |
| *Acer platanoides* | 87 | 29.1 | 5.5 (1.4) | 2.5 (1.3) | 1.2 (0.7) |
| *Ulmus americana* | 87 | 28.3 | 10.1 (7.1) | 6.9 (3.6) | 3.5 (1.8) |
| *Acer pseudoplatanus* | 20 | 28.9 | 1.8 (1.1) | 1.1 (0.7) | 0.5 (0.3) |
| 29 other species | 351 | - | 22.8 | 3.7 | 1.9 |
| TOTAL | 757 | - | 50.2 (5.9) | 21.3 (2.5) | 10.6 (1.2) |
| 5. Natural-area Urban Park (Point Pleasant, 75 ha, 8 sub-plots of 0.04 ha) | | | | | |
| *Picea rubens* | 259 | 17.3 | 809.4 (204.6) | 106.2 (15.8) | 53.1 (7.9) |
| *Picea snags* | 35 | 11.8 | 109.4 (52.8) | 4.1 (2.5) | 2.1 (1.4) |
| *Picea glauca* | 27 | 18.3 | 84.4 (68.3) | 12.1 (11.2) | 6.1 (5.6) |
| *Pinus strobus* | 26 | 31.4 | 81.3 (20.5) | 26.9 (16.3) | 13.5 (8.2) |
| 9 other species | 75 | - | 234.3 | 27.4 | 13.7 |
| TOTAL | 422 | - | 1318 (165) | 176.8 (12.4) | 88.4 (6.2) |
| 6. Natural-area Urban Park (Fleming, 45 ha, 8 sub-plots of 0.04 ha) | | | | | |
| *Acer rubrum* | 169 | 8.5 | 528.1 (87.7) | 13.9 (1.9) | 6.9 (1.0) |
| *Betula papyrifera* | 96 | 10.3 | 300.0 (91.1) | 13.9 (3.9) | 7.0 (1.9) |
| *Picea rubens* | 75 | 18.0 | 234.4 (70.6) | 34.5 (16.4) | 17.3 (8.2) |
| *Pinus strobus* | 61 | 19.9 | 190.6 (65.1) | 26.5 (8.9) | 13.3 (4.5) |
| *Tsuga canadensis* | 13 | 21.4 | 40.6 (31.3) | 5.7 (4.6) | 2.9 (2.3) |
| 12 other species | 91 | - | 284.5 | 13.7 | 6.9 |
| TOTAL | 505 | - | 1578 (219) | 109.5 (11.5) | 54.8 (5.7) |

DBHs of major species was 22-50 cm), similar to those in the South End residential neighbourhood.

The data for residential neighbourhoods in Halifax indicate a somewhat better-developed urban forest than has typically been reported in the United States, where the average urban area supports a tree density of only 52 stems/ha, and a canopy cover of 28% (Rowntree and Nowak 1991), comparable to the

institutional data for Halifax. The Halifax data are more similar, however, to cover values in northeastern U.S. cities, which average 24%-37% overall, and 46% in residential neighbourhoods (Rowntree 1984).

The stands of forest in the two natural-area urban parks have values of tree density (average 1448 stems/ha), canopy cover (95.0%), basal area (34.3 $m^2$/ha), and biomass (average 143 t/ha) that are within the range of mature forests in rural Nova Scotia. Freedman et al. (1986) studied four stands of natural, mature, spruce-dominated forest in central Nova Scotia using methods similar to those in the present study, and found a range of tree density of 1.71-2.56 $\times$ $10^3$ stems/ha (average 1.92 $\times$ $10^3$ stems/ha), basal area of 28-45 $m^2$/ha (average 37 $m^2$/ha), and above-ground biomass of 112-233 t/ha (average 159 t/ha).

However, the natural-area urban parks and rural forests differ in some other aspects of forest structure. In particular, the stands in Point Pleasant and Fleming Parks have relatively few snags (that is, dead but still-standing trees) and little coarse-woody debris, because these are regularly "cleaned" from the stands as part of routine park management. Overall, however, within the limitations of this rather coarse comparison, the stands in the natural-area urban parks in Halifax are structurally similar to natural conifer-dominated forests elsewhere in Nova Scotia.

Although the tree density of the oldest residential neighbourhood (South End, 145 stems/ha) is considerably smaller than in the natural-area urban parks (1448 stems/ha), the biomass of these two stands of urban forest is similar (131 t/ha and 143 t/ha, respectively). This is because of the large sizes of average trees in the South End, compared with the natural-area stands, which have a heterogenous size spectrum containing both smaller and larger trees.

3. *Carbon Density in the Urban Forest*

The average carbon content of the above-ground tree biomass of the oldest residential neighbourhood (South End; 65.5 t/ha) is only slightly smaller than that of the mature stands of the two natural-area urban parks (Point Pleasant and Fleming; 71.6 t/ha). The younger residential neighbourhoods are in earlier successional stages, and have correspondingly smaller carbon densities in their tree biomass (Clayton Park, 8.5 t/ha; Fairview, 9.5 t/ha), as do the relatively sparsely treed institutional areas (10.6 t/ha). These data for Halifax compare favourably with data for urban forests in the United States, where average carbon storage has been estimated to be about 27 t/ha (Rowntree and Nowak 1991). Somewhat smaller carbon densities were found in a study of urban forests in the greater Chicago area, where trees store an average of 17 tC/ha in the city, and 22 t/ha in a nearby urbanizing area that still supports some natural tree cover (McPherson 1994; Nowak 1994b).

For perspective, it is useful to note that the amount of carbon stored in trees in the mature residential neighbourhood (i.e., 65.5 t/ha; South End) is equivalent to the carbon content of approximately 104 $\times$ $10^3$ litres of gasoline, 125 $\times$ $10^3\,m^3$ of natural gas, 71.2 $\times$ $10^3$ kg of anthracite coal, and 81.9 $\times$ $10^3$ kg of bituminous coal (these data assume the following carbon densities of fuels: gasoline, 0.63 kgC/l; natural gas, 0.525 kgC/$m^3$; anthracite coal, 0.92 kgC/kg; bituminous coal, 0.80 kgC/kg; Freedman and Keith 1995).

It would be possible to increase the quantities of carbon stored in tree biomass in the urban forests of Halifax. Such a change might be desired as a component of an integrated strategy of reducing net emissions of radiatively active gases, by increasing forest biomass in rural and urban lands. In urban areas, this objective would best be approached by optimizing tree spacing and longevity to maximize carbon storage in the mature urban forest, while also attaining the many non-carbon benefits of increasing numbers of trees in urban areas, as previously noted (Rowntree and Nowak 1991; McPherson 1994; Nowak 1993, 1994b; Nowak et al. 1994; Freedman and Keith 1995). In the United States, for example, it has been estimated that urban areas contain about 225-million tree-planting opportunities, in which sub-optimal tree densities could be subjected to fill-planting (Sampson et al., 1992). It has also been estimated that the planting of 10-million urban trees each year over a ten-year period in the U.S. would offset the emissions of 363 $\times$ $10^6$ tonnes of $CO_2$-carbon over the next 50 years, including 77 $\times$ $10^6$ t by direct sequestration and 286 $\times$ $10^6$ t through reduced energy requirements for cooling and heating buildings (Nowak 1993).

There would, of course, be a need to accommodate potential problems associated with increased numbers of urban trees, such as obstructions of views and access, increased leaf and branch litter, interference with utility lines, shading of lawns and gardens, heaving of paving, obstruction of sewers and rain gutters, and seasonal emissions of pollen, to which some people have allergies. However, these drawbacks should be viewed as being much less substantial to society at large, in comparison to the many important benefits of the urban forest. Moreover, most problems with urban trees can be easily dealt with by sensibly planning their locations, and by planting appropriate species, particularly native ones.

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# Malocclusion in the Jaws of Captive Bred Arctic Wolves, *Canis lupus arctos*

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Similar abnormalities in the skulls of captive Arctic Wolves (*Canis lupus arctos*) and a wild Arctic Wolf found dead on Ellesmere Island, Northwest Territories, in 1986 are described. The malocclusion is likely to be recessively inherited and would be expressed more frequently in association with increased levels of inbreeding. A re-shaping of the skulls may have occurred due to the effects of the malocclusive trait. The Ellesmere skull was short and wide in comparison to the captive skulls which were long and narrow. The focus of effect was in a foreshortening of the rostrum and the resulting shortened toothrow.

Key Words: Arctic Wolf, *Canis lupus*, skull abnormalities, captive, wild, recessive, inbreeding, malocclusion, Ellesmere Island, Northwest Territories.

Clutton-Brock et al. (1994) described an anomalous (reported as a ≥4 year old adult male) Arctic Wolf (*Canis lupus arctos*) skull taken from one of two dead Wolves found on Ellesmere Island, Canada, in 1986. The skull was reported as exhibiting severe abnormalities of the jaws (malocclusion). The authors suggested possible explanations, including the hypothesis that the skull was from a wolf-dog hybrid. The authors later concluded that the Ellesmere skull showed no evidence of hybridization but instead was from a Wolf with severe jaw abnormalities.

Mating is possible between Arctic Wolves and domestic Dogs [*Canis familiaris*] (Maagaard and Graugaard 1994). According to assertions made by Arctic natives, Soper (1940) wrote that crosses between Arctic Wolves and Eskimo Dogs appeared to be a fairly regular phenomenon. Although interbreeding and production of fertile offspring between Wolves and Dogs is well documented (Young and Goldman 1944), gene flow has been mostly unidirectional, from Wolves into Dogs. Limited postulated evidence exists of introgression from Dogs into wild Wolf populations, particularly in Italy (Boitani 1984), although Randi et al. (1993) and Lorenzini and Fico (1995) have questioned introgression as a substantial threat in that country. However, interbreeding, in itself, would not necessarily cause such reported abnormalities (Iljin 1941). I describe similar abnormalities for skulls of captive bred Arctic Wolves and suggest a possible cause for the abnormality reported by Clutton-Brock et al. (1994).

In the United States, a line of Arctic Wolves has been bred in captivity since 1983 and all existing captive *arctos* from this line are directly descended from a founding pair obtained from the Stanley Park Zoo in Vancouver, British Columbia (S. Smith and F. W. Halvorson, USDA permit #42-B-059 Iowa and #41-A-301 Minnesota, personal communication, 1995). The founders were directly descended from a brother and sister pair taken from Axel Heiberg Island (5 km west of Ellesmere Island) in 1961, studied and bred by Kuyt (1969, 1972), and donated to the zoo in 1968. No breeding data from the zoo, which may now be closed, could be obtained.

In 1983 the founding pair produced a litter of two pups. A female from this breeding was then repeatedly bred back to her father, producing several litters (Figure 1). The founding female had since died and no other Arctic Wolves could be found to facilitate an outcross. Most of the pups from the father/daughter cross were donated to other facilities, although a brother and sister had an accidental breeding, producing four offspring, three (75%) of which exhibited malocclusion of the jaws (F. W. Halvorson, personal communication, 1995). Another facility, also in possession of a donated brother and sister pair from this line, also produced a litter of four offspring, two (50%) of which exhibited the malocclusion (F. W. Halvorson, personal communication, 1995).

The pups from the accidental breeding were allowed to mature into adulthood and two females of the three wolves exhibiting the abnormality were then donated back to the original breeding facility where they were euthanized and the skulls removed. The malocclusion expressed itself most often when brother and sister matings from this line of *arctos* occurred. However, some of the offspring (10%) from the father/daughter cross also exhibited the abnormality.

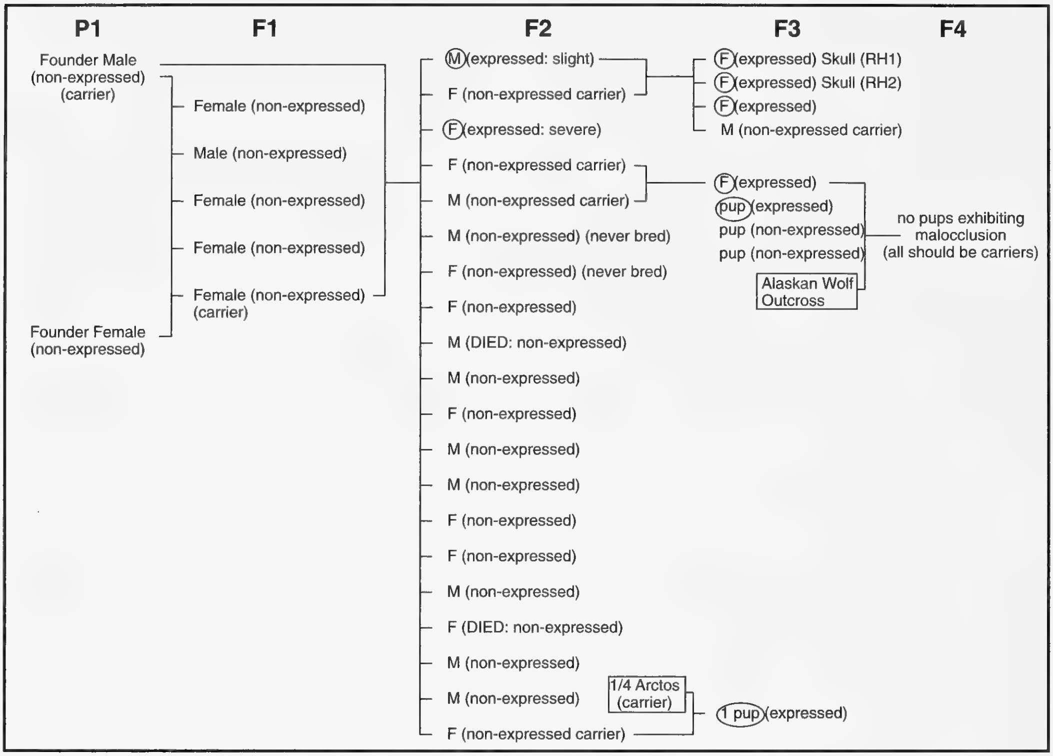


FIGURE 1. Lineage of malocclusive captive Arctic Wolves (expressed and non-expressed).

Degree of malocclusion varied from slight to severe, initially exhibiting itself in some wolves as young as 5 weeks of age and in others as old as 5 to 6 months. Malocclusive pups at other facilities have since been outcrossed with other Wolf subspecies. No offspring were produced exhibiting the abnormality (S. Smith, personal communication, 1995). However, when outcrossed Wolves (carriers) were bred back to one another, the malocclusion was evident once again in the offspring (S. Smith, personal communication, 1995), indicating that the malocclusion may be the result of a recessive gene or polygenic trait.

The skulls removed from the two adult (approx. 2 years old) malocclusive female captive Arctic Wolves were sent to the author, cleaned, and measured by the author and R. M. Nowak (USFWS, Office of Scientific Authority). Ten cranial measurements were taken as described by Nowak (1996). Both skulls exhibited overall wolf morphology (Table 1). Ratios (greatest length to zygomatic width and alveolar length of toothrow (P1 to M2) to maximum width across outer sides of crowns of P4) calculated from cranial measurements of a series of male (n=14) and female (n=7) *arctos* were compared with those of the male Ellesmere and the two female captive skulls. The captive skulls appeared to be longer and more narrow than the male Ellesmere skull. Ratios (greatest length to zygomatic width) from the captive skulls were greater than 2 standard deviations above the female series ratio mean. The ratio calculated from the male Ellesmere skull was exactly 2 standard deviations below the ratio mean of the male skull series. Ratios (alveolar length of toothrow to maximum width across outer sides of crowns of P4) from the captive skulls were just beyond 2 standard deviations below the female series ratio mean. Normally in Wolves, values for alveolar length of toothrow are slightly greater than values for maximum width across outer sides of crowns of P4, in which the opposite was true in regards to the abnormal skulls, although this condition has also been observed occasionally in other specimens, especially in Wolves from the arctic (R. Nowak, USFWS, personal communication, 1996). The characteristics of the malocclusion were evident in the portion of the rostrum anterior to the fourth premolars. The facial regions of the skulls were foreshortened and undershot by the mandible. A mis-alignment of the upper third premolars was evident as well (Figure 2). Buchalczyk et al. (1981) have also reported a bilateral skewness of P3 in

TABLE 1. Skull measurements (mm) of two malocclusive captive adult female Arctic Wolves (RH1, RH2) and a series of female *arctos* (n=7).

| Skull Measurements (mm) | RH 1 | RH 2 | Skull Series† (mean) | | Skull Series† (SD) |
|---|---|---|---|---|---|
| Greatest length* | 237.0 | 237.0 | 244.40 | ± | 6.45 |
| Zygomatic width* | 121.0 | 125.0 | 135.70 | ± | 2.87 |
| Alveolar length of toothrow (P1 to M2)* | 72.0 | 73.4 | 84.26 | ± | 2.03 |
| Maximum width across outer sides of crowns of P4* | 75.0 | 74.5 | 78.90 | ± | 1.42 |
| Maximum width across inner edges of alveoli of P1* | 28.8 | 29.8 | 31.07 | ± | 0.60 |
| Width of frontal shield* | 64.1 | 63.0 | 61.49 | ± | 2.64 |
| Height from alveolus of M1 to lowest point of orbit* | 39.8 | 39.0 | 40.13 | ± | 1.79 |
| Depth of jugal* | 15.1 | 16.1 | 18.41 | ± | 0.87 |
| Crown length of P4* | 24.9 | 25.0 | 26.37 | ± | 0.64 |
| Maximum crown width of M2* | 12.6 | 12.5 | 13.49 | ± | 0.49 |
| Greatest diameter of tympanic bullae | 31.5 | 32.0 | — | | — |
| Anteroposterior length of C1 | 13.4 | 13.5 | — | | — |
| Crown length of P3 | 16.2 | 16.4 | — | | — |
| Maximum crown width of M1 | 21.0 | 21.5 | — | | — |
| Alveolar length from p1 to m3 | 97.6 | 95.7 | — | | — |
| Mandibular depth taken between p3 and p4 | 24.6 | 24.5 | — | | — |
| Crown length of p4 | 15.7 | 15.5 | — | | — |
| Crown length of m1 | 29.2 | 28.6 | — | | — |

*Measurements used by Nowak (1996).
†Nowak, R. M. 1973. North American Quaternary *Canis*. Ph.D. dissertation (unpublished data). University of Kansas.

skulls collected from Wolves in Poland, although the occurrence of malocclusion was not mentioned. The malocclusion was roughly 15 mm (anteroposterior distance between upper and lower incisors). Each of the malocclusive skulls exhibited the same abnormalities and, after review of the abnormal skull ratios in relation to the series ratio means, it seems that a re-shaping of the skulls may have occurred due to the effects of the trait. Similar jaw abnormalities have also been observed in a series of skulls from captive Red Wolves (*Canis rufus*) at The Slater Museum, University of Puget Sound, Tacoma, Washington (USA) (R. M. Nowak, personal communication, 1995).

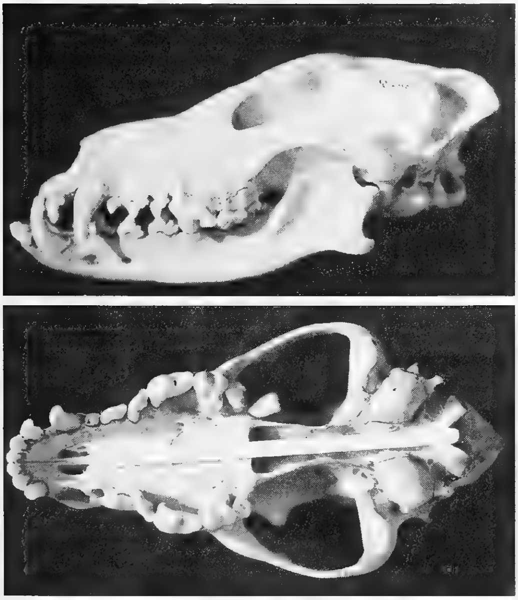

FIGURE 2. (a) Upper: Left side view of a captive female Arctic Wolf skull (RH2) exhibiting the malocclusion. (b) Lower: Palatal view showing compacted third premolars in the captive skull.

These observations may indicate that malocclusion in captive Arctic Wolves is probably associated with a recessive gene or a polygenic trait that may occasionally be expressed in the wild population. Due to the fact that the Wolf found on Ellesmere Island was an adult, it is apparent that malocclusive Wolves can survive into adulthood. Wolves with such abnormalities could probably kill Arctic Hare (*Lepus arcticus*) but probably not larger prey such as Musk Oxen (*Ovibos moschatus*), although the entire pack would share in consuming the kill, thereby allowing a malocclusive Wolf to survive (L. D. Mech, NBS, personal communication, 1995).

*Arctos* is probably the least studied North American subspecies of Wolf. There are no data available regarding population density or genetics for this subspecies. Inbreeding may play a role in the expression of this abnormality, although more research is needed. If hybridization was the cause of the malocclusion in the Ellesmere Wolf, both parents, Wolf and Dog, would had to have been carriers

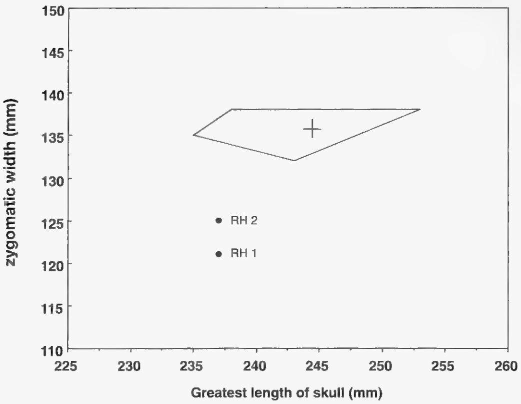


FIGURE 3. Bivariate position comparison of skull measurements (greatest length and zygomatic width) in a series of female *Canis lupus arctos* (n=7) and two malocclusive captive Arctic Wolves (RH1, RH2). + = series mean.

of the recessive trait. If this was the case, the gene(s) would nevertheless still have been evident in the wild population prior to the hybridization event. Whether the trait was originally brought into the Arctic Wolf population through hybridization or was always evident in the wild can only be speculated upon. Clutton-Brock et al. (1994) have suggested that recent changes in the skulls of Arctic Wolves, especially a reduction in size and change in shape, may be the result of interbreeding between Wolves and Dogs. However, Nowak (in press) has questioned whether there have been any such changes. Should there indeed have been such changes, they may be due to subtle influences of the malocclusive

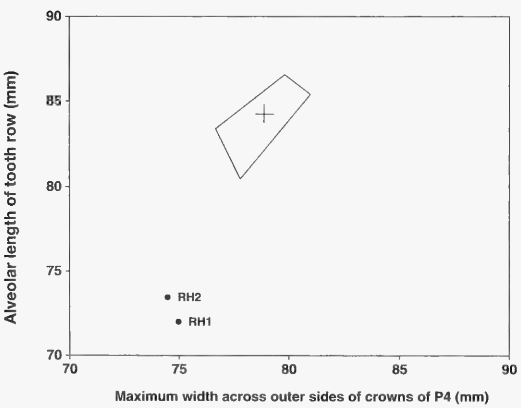


FIGURE 4. Bivariate position comparison of skull measurements (Alveolar length of toothrow and maximum width across outer sides of crowns of P4) in a series of female *arctos* (n=7) and two malocclusive captive Arctic Wolves (RH1,RH2). + = series mean.

trait, which may be multi-factorial in relation to effects on cranial dimensions (Figure 3 and 4). Although all of the abnormalities in the skulls of the captive females apparently resulted from the malocclusive condition, the extent to which factors involving captivity may have influenced the skulls is unknown. The malocclusive trait may be inherent in other Wolf populations as well (Vila et al. 1993), although it may express itself more frequently under captive breeding conditions where inbreeding may be a factor.

Wolves are not immune to the effects of inbreeding depression. Lairke and Ryman (1991) suggest that deleterious homozygous alleles may be fairly common in natural Wolf populations. Results from a pedigree analysis using the SAS program INBREED (1996) imply that this abnormal condition is genetically based and is most probably the result of a recessive gene or polygenic trait possibly expressed more frequently through increased levels of inbreeding in captivity. However, due to finding this condition in the wild Ellesmere Wolf, the abnormality itself was not the result of captive breeding, although inbreeding may increase the probability and frequency of expressing the abnormality. Inbreeding coefficients were fairly high for the Wolves expressing the abnormality. Coefficients for captive Arctic Wolves expressing the abnormality ranged from 0.250 for animals resulting from the father/daughter cross to 0.375 for animals resulting from the brother/sister cross. Coefficients are very likely to be higher depending on the exact relatedness of the founders.

The wild Ellesmere Wolf and the captive Wolves exhibiting the malocclusion originated from two separate but nearby islands. However, Arctic Wolves can freely travel across the ice between the islands, which would facilitate gene flow (L. D. Mech, personal communication, 1995). The malocclusive trait may still occur in parts of the Arctic Wolf population, due in part to gene flow between the island populations, and may be expressed more frequently in association with increased levels of inbreeding within the population. Further research is needed concerning population dynamics, long range movements to and from other Arctic islands, patterns of dispersal, geographic isolation from other Wolf subspecies, and levels of inbreeding and hybridization with Dogs, if any, in the Arctic Wolf population.

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# Impacts of Habitat Fragmentation on Pairing Success of Male Ovenbirds, *Seiurus aurocapillus*, in Southern New Brunswick


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Populations of some species of nearctic-neotropical migrant birds have been declining in recent years, and much attention has focused on fragmentation of North American forests by agriculture, urbanization, and forest harvesting as one of the causes for the declines. This study evaluated the hypothesis that fragments of mature forest in a managed-forest landscape in southern New Brunswick were suboptimal habitat for Ovenbirds (*Seiurus aurocapillus*) compared to large tracts of similar forest. There were no significant differences in pairing success or territorial density of male Ovenbirds between fragments and contiguous forest sites in 1992 and 1993. However, when only smallest fragments were considered mating success and density were lower but differences were not significant. Potential food abundance for Ovenbirds did not differ between fragment and large forest sites, nor between mated and unmated male territories. This study suggests that fragmentation of mature forest in a largely forested landscape may not cause the adverse effects reported for Ovenbirds elsewhere.



Key Words: Ovenbird, *Seiurus aurocapillus*, nearctic-neotropical migrant, habitat fragmentation, New Brunswick.


Concern has been expressed that in recent years a number of nearctic-neotropical migrant songbird species, especially those breeding in forested habitats, have been declining (Aldrich and Robbins 1970; Briggs and Criswell 1979; Robbins 1979; Terborgh 1989; Hagan and Johnston 1992). Forests throughout the North American breeding range of these species are becoming increasingly modified by human activities. Forest fragmentation is one such modification and, in recent years, impacts of forest fragmentation on nearctic-neotropical migrant birds have attracted attention. Several studies have suggested that some species tend to be intolerant of habitat area reduction: i.e., they are "area-sensitive" (Galli et al. 1976; Whitcomb et al. 1981; Robbins et al. 1989).

Although some forest bird species appear to be area-sensitive, occurrence or density of birds may be an inappropriate measure for estimating minimum area requirements. Population density is not always a suitable indicator of habitat quality (Van Horne 1983; Vickery et al. 1992). Patch sizes corresponding to the area of minimum occurrence may be in the range of marginal rather than preferred habitat for area-sensitive species (Gibbs and Faaborg 1990). Studies by Ficken and Ficken (1966) Best (1977) and Probst and Hayes (1987) suggest that marginal habitats for some species were occupied by populations with low levels of reproductive success. These populations may be maintained by an influx of individuals from more productive habitats (Askins and Philbrick 1987; Askins et al. 1987; Pulliam 1988). Forest fragments may represent marginal habitat for area-sensitive birds for a variety of reasons, including increased rates of nest predation (Andren and Angelstam 1988; Wilcove 1985; Gates and Gysell 1978), brood parasitism (Brittingham and Temple 1983), interspecific competition (Ambuel and Temple 1983; Whitcomb et al. 1981), decreased insect abundance and diversity (Whitcomb et al. 1981), and a reduced likelihood of maintaining critical microhabitats in small fragments for species which rely on a range of conditions (Wilcove et al. 1986).

Forests in New Brunswick are currently undergoing alteration due to intensive forestry practices. This alteration differs from the type of fragmentation which has attracted most of the research effort to date, namely fragmentation of the eastern deciduous forest due to agriculture and urbanization. Instead of agricultural and/or urbanized areas, mature forest fragments in eastern Canada exist in a mosaic of regenerating forest, and tend to exhibit comparatively low isolation and high interconnectivity. Effects of habitat fragmentation on forest birds in this type of landscape are poorly understood. However, some species shown to be intolerant of fragmentation in the eastern United States are apparently unaffected by fragmentation of mature boreal forest through forest harvesting (Welsh 1987).

Our study evaluated the hypothesis that fragments of mature forest in a managed-forest landscape rep-

resent suboptimal habitat for Ovenbirds (*Seiurus aurocapillus*), as compared to large contiguous tracts of similar forest. Pairing success of male birds was chosen as an index of habitat quality, as resource quality is an important factor influencing mate selection by females for those species in which the male provides a resource (e.g., territory) prior to mating (Searcy 1982). There is some evidence that females exhibit a greater sensitivity to habitat quality, insofar as it affects reproductive success. Females may be more likely to select territories based on features enhancing offspring production, such as nest site availability and quality, whereas males may be more likely to select territories based on features which enhance territory defense or mate attraction, such as song perch availability and quality (e.g., Zimmerman 1982; Sedgewick and Knopf 1992).

To test the hypothesis, we predicted that pairing success of male Ovenbirds would be lower on mature forest fragments than on contiguous forest sites. Ovenbirds were selected for intensive study because they are a forest-interior species (Whitcomb et al. 1981; Robbins et al. 1989), and they were abundant in the mature tolerant hardwood forests of southern New Brunswick.

## Study Area

The study was conducted in Albert and Saint John counties in southern New Brunswick, within and west of Fundy National Park (FNP) (45°65'N, 65°15'W). The park is a 207 $km^2$ contiguous tract of mature forest. The forest consists largely of tolerant hardwood (Sugar Maple, *Acer saccharum*, and Yellow Birch, *Betula allegheniensis*, with a minor Red Spruce, *Picea rubens*, component) and mixedwood stands (Red Spruce - tolerant hardwoods). The landscape surrounding FNP is largely forested and is subject to intensive forest harvesting, resulting in extensive fragmentation of mature forest. A large proportion of the coniferous and mixedwood stands have been harvested, and replaced with either naturally regenerating stands or plantations of Black Spruce (*Picea mariana*), White Spruce (*Picea glauca*), or Jack Pine (*Pinus banksiana*). Tolerant hardwood stands have been subject to little or no harvest pressure.

Criteria for selecting study sites were as follows: (1) presence of a mature (>40 yr), closed, tolerant hardwood canopy; (2) absence of well-developed subcanopy and shrub layers; (3) lack of recent disturbance by logging in fragments; and (4) presence of a well-defined edge on all sides of fragments. The third criterion could not be attained for all fragments. Scattered Red Spruces were often selectively removed from fragments during recent harvests of surrounding stands. Other fragments appeared to have been selectively logged for Red Spruce at some time within < 30 years. As a result, most fragments contained a nearly pure hardwood canopy, while FNP sites invariably contained a few scattered, mature Red Spruces. Although all fragment sites were enveloped by abrupt edges, several sites were surrounded by regenerating stands on only three sides, and separated from other mature forest tracts by road openings.

We located 40 tolerant hardwood fragments between 1.0 ha and 51.5 ha in size (average = 11.1 ha) throughout a 25354 ha area west of FNP. Five forest fragments near FNP were selected for study in 1992, with two others added in 1993. Three plots within FNP were selected for study in 1992, with one more added in 1993. The seven fragments meeting our criteria ranged from 2.5 ha to 38.5 ha (mean = 12.6 ha), and six of these were only 2.5 ha to 16.3 ha in size (Table 1.).

## Methods

To determine pairing status, male Ovenbirds were followed and closely observed for evidence of being mated. Observations commenced approximately one week after female birds were detected in breeding habitat, with all observations occurring between 3 June and 30 June. Males were classified as paired if they were observed interacting with a female or fledglings (Probst and Hayes 1987). The presence of a female responding to the male's song with a "tsip-series" vocalization (Lein 1980) was also assumed to indicate a mated pair. Males were followed until such evidence of pairing was observed, or for a maximum of 90 minutes. We assumed that pairing status determinations would be valid within 90 minutes, since Gibbs and Faaborg (1990) reported that curves describing the cumulative percentage of male ovenbirds classified as paired versus total elapsed time reached 100% at 67 minutes. Territories were marked for ease of relocation by flagging singing perches as males were followed.

### *Food Availability*

Five 0.02 ha sample plots were located in each of 20 Ovenbird territories (10 in FNP, 10 in fragments) by randomly selecting compass coordinates and distances from a point at the approximate center of each territory. Habitat variables were measured in these plots following the example of Smith and Shugart (1987). Distance to the nearest edge was also measured for each sample plot. Five 0.1 $m^2$ litter samples were collected from each 0.02 ha plot. Invertebrates were extracted from these litter samples by hand sorting and placed in a 70% ethyl alcohol solution, and were later air dried at 50°C for 24 hours. Masses and numbers of individuals were recorded. Total mass of all invertebrates collected per sample was assumed to be a suitable index of potential prey availability, since most invertebrate groups are consumed by Ovenbirds in amounts proportional to their availability on the forest floor (Stenger 1958).

*Statistical Tests*

Pairing success of males on fragments and FNP sites were compared using 2 x 2 contingency tables and the Fisher exact test (Zar 1984). Ovenbird densities and invertebrate biomass were compared using the Student's *t*-test (two-tailed). Probability levels < 0.05 were considered significant.

## Results

The proportion of unmated male Ovenbirds was similar between fragment and FNP sites (Table 1). Pairing success of male Ovenbirds did not differ between years on fragment sites ($P$ = 1.00), FNP sites ($P$ = 1.00), or all sites combined ($P$ = 0.71). Therefore, years were combined to compare pairing success between fragment and FNP sites. There was no difference between pairing success of male Ovenbirds on fragments (82%) versus FNP sites (84%) ($P$ = 1.00). However, one large fragment (Number 7, 38.5 ha.) contained most (67-80%) of the male Ovenbirds observed on fragments (Table 1). When this large fragment was removed from the sample, the difference between pairing success of males on fragments (40%) and FNP sites (84%) was more pronounced ($P$ = 0.07).

Mean density of territorial male Ovenbirds on fragment sites (1.1/10 ha) was somewhat lower than on FNP sites (1.9/10 ha)($t$ = -1.35, $P$ = 0.19). Lack of statistical difference is likely due to small sample size. Cumulative densities (total number of males on all sites divided by total area of all sites) were similar between fragment (2.0/10 ha) and FNP sites (2.0/10 ha) ($t$ = -0.05, $P$ = 0.96). When the largest fragment was removed from the sample, mean density was lower on fragment sites (0.7/10 ha) than on FNP sites (1.9/10 ha) ($t$ = -2.39, $P$ = 0.03), but cumulative density on the smallest fragment sites (1.0/10 ha), although lower, was not statistically different from FNP sites (2.0/10 ha) ($t$ = 1.14, $P$ = 0.37).

Mean leaf-litter invertebrate biomass did not differ between Ovenbird territories on fragment sites (0.012 g/0.1 $m^2$) and FNP sites (0.013 g/0.1 $m^2$) ($t$ = 0.14, $P$ = 0.89). There was also no difference between mean invertebrate biomass on territories of mated males (0.012 g/0.1 $m^2$) and unmated males (0.016 g/0.1 $m^2$) ($t$ = -0.79, $P$ 0.43). Leaf-litter invertebrate biomass was significantly correlated only with one habitat variable (i.e., canopy cover) (Table 2).

## Discussion

Reduced rates of pairing success of male Ovenbirds in forest fragments have been reported from New Jersey (Wander 1985), Missouri (Gibbs and Faaborg 1990; Van Horn et al. 1995), Pennsylvania (Porneluzi et al. 1993), Quebec-Ontario (Villard et al. 1993), and Maine (Hagen et al. 1996). Pairing success in these studies ranged from 19%-59% in fragments, and from 55%-85% in large forest plots. The high levels of pairing success of male Ovenbirds in the forests examined in this study (82% on fragments, 84% on FNP sites), and the lack of difference in pairing success between fragments and large, contiguous forest sites (FNP), contrast sharply with these studies. However, with the exception of Hagen et al. (1996), the other stud-

TABLE 1. Number of territorial male Ovenbirds found on fragment and Fundy National Park sites during 1992 and 1993 in southern New Brunswick.

| Site | Fragment size (ha) | Plot size (ha) | Distance to mature forest[a] (m) | Percentage of regenerating forest[b] within 1-km radius | Number of territorial males[c] 1992 | 1993 |
|---|---|---|---|---|---|---|
| Fragment 1 | 2.5 | 2.5 | 40 | 43.4 | 0 | 0 |
| Fragment 2 | 5.6 | 5.6 | 20 | 61.3 | 0 | 0 |
| Fragment 3 | 7.6 | 7.6 | 25 | 40.6 | 1P,1N | 0 |
| Fragment 4 | 8.7 | 5.9 | 40 | 55.2 | 1N | 1P |
| Fragment 5 | 9.3 | 9.3 | 200 | 65.0 | ns[d] | 0 |
| Fragment 6 | 16.3 | 12.1 | 80 | 70.1 | ns | 1N |
| Fragment 7 | 38.5 | 27.1 | 130 | 41.8 | 8P,1N | 8P |
| subtotal | – | 70.1 | – | – | 9P,3N | 9P,1N |
| Park 1 | 20700 | 14.9 | 0 | 0 | 4P,1N | 3P |
| Park 2 | 20700 | 16.6 | 0 | 0 | 3P,1N | 0 |
| Park 3 | 20700 | 22.8 | 0 | 0 | 5P,1N | 3P,1N |
| Park 4 | 20700 | 27.0 | 0 | 0 | ns | 3P,1N |
| subtotal | – | 81.3 | – | – | 12P,3N | 9P,1N |

[a]stand edge-to-edge distance to the closest mature forest block
[b]clearcuts and plantations <15 years old
[c] P=paired, N=non-paired
[d]not surveyed

TABLE 2. Correlation coefficients between leaf-litter invertebrate biomass and habitat variables during June 1992 and 1993 in southern New Brunswick.

| Habitat variable | *r* | *P* |
|---|---|---|
| ground cover | -0.07 | 0.49 |
| density of shrubs <1.5 m in height | -0.01 | 0.96 |
| density of shrubs >1.5 m in height | -0.09 | 0.40 |
| canopy cover | 0.20 | 0.05 |
| density of trees 3.0-6.9 cm dbh | 0.04 | 0.69 |
| density of trees 7.0-14.9 cm dbh | 0.03 | 0.76 |
| density of trees 15.0-22.9 cm dbh | -0.02 | 0.87 |
| density of trees >22.9 cm dbh | -0.08 | 0.41 |
| relative basal area of coniferous trees | -0.16 | 0.12 |
| distance to nearest opening | 0.03 | 0.80 |

ies were conducted in areas where forest fragments were embedded in a mosaic of agricultural land.

Hagen et al. (1996) examined an industrial forest landscape in north central Maine. They observed higher densities of male Ovenbirds in fragmented tracts, a reverse of the trend reported in the other studies. They suggest these higher densities are possibly the result of a crowding effect following the loss of habitat surrounding the fragments. They propose that behavioural dysfunction resulting from abnormally high densities may explain the lower pairing success in fragments in their study. We observed no crowding effect in our fragment sites, as densities were either similar to or lower than densities in contiguous forest plots. However, our fragment sites were surrounded by young clearcuts or plantations ranging in age from 3 - 15 years old. It seems plausible that any crowding effect may have dissipated in the years following harvest of the mature stands.

Our fragment sites were chosen to represent the extreme with regard to size in an effort to better identify potential impacts. Although our smaller fragments contained few Ovenbirds, density and pairing success for male Ovenbirds in the largest fragment (38.5 ha) were very similar to values recorded for the FNP plots. In contrast, several of the other studies reported lower densities and rates of pairing success in fragments much larger than our largest fragment. For example, Van Horn et al. (1995) recorded pairing success rates ranging from 0.0% to 27.7% in five fragments between 150 ha and 350 ha in size. Of the six smallest fragments studied by Porneluzi et al. (1993) (9.2 ha to 41.9 ha), only one plot (19.4 ha) contained territorial Ovenbirds. These results suggest that the threshold for negative impacts of fragmentation might occur at a much lower fragment size in forested landscapes than in the more modified agricultural landscapes.

Although the absence of Ovenbirds from many smaller fragments resulted in a low mean density for fragments, cumulative densities, which essentially weight each fragment or plot relative to its size, were almost identical between FNP and fragment sites. Study sites in FNP usually contained extensive sections which were unoccupied by Ovenbirds but which appeared identical to those parts of the stands which were occupied. Hence, it is likely that if plots similar in size to our smaller fragments were randomly placed throughout the FNP study sites, many would have been found to be devoid of Ovenbirds. However, the absence of Ovenbirds on small fragments may have been due to a reduced likelihood of a bird finding and using a small patch, and not an inherent deficiency of habitat quality resulting from fragment size.

It should be noted that pairing success is one of many factors contributing to overall reproductive output. Nesting success and fledgling survival might also be affected by habitat fragmentation. For example, nest predation and parasitism have been shown to be significant causes of reduced reproductive success for many bird species within forest fragments located within agricultural or suburban landscapes. Robinson (1992) reported nest predation rates of 80% and nest parasitism rates of 76% for neotropical migrants in forest fragments in Illinois. Nest parasitism would not be a factor in forested landscapes, because Brown-headed Cowbirds (*Molothrus ater*), the only obligate nest parasite in eastern North America, are extremely uncommon in these habitats. No Cowbirds were encountered during the two years of our study. However, nest predation was increased by fragmentation of mature forest in forested landscapes in Maine (Small and Hunter 1988) and Pennsylvania (Yahner and Scott 1988). Unfortunately, our sample of nests was too small to estimate nest predation rates for our study area. Only five Ovenbird nests were located; of these one was abandoned shortly after it was found, one was destroyed by heavy rain, and three successfully fledged four young each.

Food availability is an important factor in determining habitat quality. Ovenbirds feed mainly on leaf-litter invertebrates. It was conceivable that abundance of leaf-litter fauna in forest fragments might be affected by increased evaporation rates and decreased litter moisture rates caused by reduction of forest area (Lee 1978). However, we found no difference in invertebrate biomass between fragment sites and FNP sites, or between territories of mated and unmated males. Smith and Shugart (1987) found that a variety of habitat features were important in predicting prey abundance for Ovenbirds. We replicated their study, adding distance to the nearest large opening as a habitat variable. However, we found no correlation between invertebrate biomass and opening distance, nor between invertebrate biomass and most of the other habitat variables which Smith and Shugart (1987) found to be significant.

It appears that fragmentation of mature forest within a forested landscape may not cause the deleterious effects reported for Ovenbirds where forest fragmentation is caused by non-forest habitats. Alternatively, negative effects may occur but at a much lower threshold of fragment size. Unfortunately there is little information available concerning habitat fragmentation in largely forested landscapes (but see Rosenberg and Raphael 1986; Keller and Anderson 1992; Hagen et al. 1996). The current forest harvesting pattern in New Brunswick results in relatively large, irregular, interconnected blocks of unharvested, mature forest. Small, distinct, mature forest fragments are uncommon, and represent a small proportion of the available mature forest. If this pattern continues, then fragmentation of mature forest as it occurs in New Brunswick may not be detrimental to all forest birds.

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# Renesting Intervals in Sprague's Pipit, *Anthus spragueii*

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Many bird species will attempt to raise more than one clutch in a given breeding season. For grassland songbirds, the interval between nesting attempts is usually measured indirectly because individual birds are difficult to track once a nest has failed or their chicks have fledged. Here we report observations of renesting by Sprague's Pipits (*Anthus spragueii*) carrying radio transmitters. As part of a larger study of pipit nesting ecology, we monitored activity patterns of radio-tagged adult females in 1994 and 1995. Three birds started replacement nests 10-15 days after losing a clutch, and one started a second nest 21 days after successfully fledging chicks. Such long intervals between nesting attempts support the impression that the frequency of renesting in pipits is relatively low.

Key Words: Sprague's Pipit, *Anthus spragueii*, renesting, grassland birds, radio-telemetry.

Many bird species are able to increase their reproductive output by raising more than one brood per breeding season. Passerines breeding at temperate latitudes will frequently attempt more than one nest per season, with some grassland species averaging 1.5-2.0 clutches per female per year (Maher 1973; Martin 1995). For most grassland species, estimates of renesting (or double-brooding) frequency are based largely on indirect evidence, such as clutch initiation dates and the length of a species' breeding season. The interval between nesting attempts is rarely known for grassland species because few marked populations have been studied and birds can be difficult to follow (Harris 1933; Maher 1973).

Here we report observations of renesting by Sprague's Pipit (*Anthus spragueii*) based on information collected via radio telemetry. Sprague's Pipits are small (< 25 g), ground-nesting passerines that breed in temperate grasslands of North America (Owens and Myres 1973). They tolerate a wide range of grazing pressure on their breeding grounds, but tend to be less common in heavily grazed areas (Dale 1983; Owens and Myres 1973) and in introduced vegetation (Cody 1974; Wilson and Belcher 1989; Sutter 1996). Pipits arrive in southwestern Saskatchewan in late April or early May, and females lay clutches of 4-5 eggs beginning in mid May (Maher 1973). Based on clutch-initiation dates, breeding pairs produce an average of 1.5 clutches per year and have mean incubation and nestling periods of 14 d and 11 d, respectively (Maher 1973). More information is required on the breeding biology of this species because pipit populations appear to be declining with the loss of suitable breeding habitat (Knopf 1994).

## Methods

From 13 May - 9 August 1994 and 9 May - 8 July 1995, we studied Sprague's Pipits breeding in 256 ha of native mixed-grass prairie at the south end of the Matador Provincial Community Pasture (50°41'N, 107°44'W), 30 km SE of Kyle, Saskatchewan, Canada. The general area has a flat to rolling topography and is grazed by cattle annually. Native vegetation on the study site is dominated by northern and western wheat grass (*Agropyron dasystachyum* and *A. smithii*, respectively), Junegrass (*Koeleria gracilis*) and Green Needle Grass (*Stipa viridula*). Other abundant plant species include Snowberry (*Symphoricarpos occidentalis*), sedges (*Carex* spp.), Pasture Sage (*Artemisia frigida*) and numerous forbs (Coupland et al. 1973). Plant names are taken from Looman (1982) and Vance et al. (1984).

We located pipit nests by dragging a weighted 30-m rope over the study site and carefully searching wherever the rope caused birds to flush. We also found nests after encountering incubating birds by chance, and by tracking signals from birds carrying radio-transmitters. We marked each nest by centering the site along a 10-m line and flagging the vegetation at both endpoints. Stakes or pin flags were not used because they tended to attract predators and cattle (personal observation). Nest initiation dates were estimated by candling eggs or back-dating from actual or estimated hatch dates, based on a mean incubation period of 14 d (Maher 1973; Sutter 1996). Active nests were checked every two days.

To monitor incubation activity, we captured birds by flushing them off the nest into a mist net. Each bird was outfitted with a back-pack style, motion-sensitive radio transmitter (model BD-2 or BD-2G, Holohil Systems Ltd., Woodlawn, Ontario) by passing the loop of an elastic thread harness over each wing (Brigham 1992). The mass of the transmitter and harness was 1.4-1.7 g, which represents 6-7% of a breeding female pipit's body mass (23.1-25.0 g, Sadler and Maher 1974). Each transmitter had a flex-

ible 17.5-19 cm antenna which extended beyond the bird's tail by 2-3 cm. Females were distinguished from males by the presence of a brood patch and the absence of a cloacal protuberance.

We monitored day-time activity patterns by tracking signals from radio-tagged birds with either hand-held Merlin 24 (Custom Electronics, Urbana, Illinois) or automated Lotek SRX-400 (Lotek Engineering, Aurora, Ontario) receivers attached to 3- or 5-element yagi antennas. Birds that had either successfully fledged young or abandoned their nests were tracked to determine the interval between nesting attempts.

## Results

Over the two years of this study, we found 51 pipit nests and put radio-transmitters on 32 birds. All but one of the birds we caught were clearly females, suggesting that females are primarily responsible for attending the nest in this species. The exceptional bird was within the size range of the others we caught (culmen = 9.2 - 12.7 mm; tarsus = 23.4 - 30.5 mm; right wing chord = 74 - 81 mm) and had a large brood patch, but it also had a small cloacal protuberance and may therefore have been a male.

Disturbance effects, predation and technical problems reduced the number of samples available for estimating the time interval between pipit nests. In 1994, 12 of the 19 birds we caught (63%) abandoned their nests after being disturbed at the nest site and (or) because of irritation due to the transmitter. One of these birds died during inclement weather (heavy rain), another was obviously taken by a predator, and three removed their transmitters by cutting the elastic thread harness. Signals from the other seven disappeared either because the transmitter battery died or because the bird had left the study area or been captured by a predator. Two birds subsequently returned to the study area and started new nests 10-14 days after their signals had disappeared. Disturbance and transmitter effects were less problematic in 1995, presumably because of increased experience on our part. Only three of the 13 birds we caught that year abandoned their nests (one because of injury) and two were obviously depredated.

Overall, 15 birds (seven in 1994 and eight in 1995) accepted the transmitter and showed apparently normal incubation behaviours. Two tended nests for more than two weeks before losing their transmitters, two lost their nests to predators, and seven raised chicks to fledging age. The other four birds were among nine that we followed beyond their first nesting attempt. Two of these birds were tracked to measure the time required for a bird to renest after successfully raising a clutch. One removed her transmitter eight days after her chicks had fledged, without having started a second nest. The other started a new nest 21 days after her first clutch fledged and successfully reared four more chicks. Thus, assuming this bird was behaving normally, the interval between successful pipit nests appeared to be relatively long.

The other seven birds were tracked to measure the time required to replace failed nests. One of these birds lost her transmitter and three either left the study area or were depredated within 4-7 days of losing their clutch. No evidence of renesting was observed in each case. The other three birds built replacement nests 10-15 days after abandoning their first clutch, providing additional evidence that the interval between nesting attempts is relatively long in this species.

## Discussion

Our results show that some Sprague's Pipits attempt to raise more than one brood per year at Matador, requiring 10-15 days to replace lost clutches and up to three weeks to initiate a second clutch after nesting successfully. Our estimate of the time needed to replace a lost nest is substantially longer than the two days required by Horned Larks (*Eremophila alpestris*) (Beason and Franks 1974), implying that pipits require more time to secure additional copulations, choose a new nest site and build a new nest. The interval we observed between successful nests is also longer than the seven days reported for Horned Lark (Beason and Franks 1974) and the 1-8 d reported for Baird's Sparrow (*Ammodramus bairdii*) (Cartwright et al. 1937; S. Davis, personal communication), suggesting that pipits may extend their parental care well beyond the nestling stage, as reported in the congeneric Rock Pipit (*A. spinoletta*) (Askenmo and Unger 1986).

Our estimates of pipit renesting intervals are based on the assumption that the radio-tagged birds we studied were behaving normally, which may be incorrect. Information based on radio-telemetry can be biased due to behavioural effects associated with the presence of the transmitter, especially when the transmitter is attached as a harness-style backpack (Sykes et al. 1990; Rappole and Tipton 1991). Waterfowl carrying harness transmitters will continue to incubate, for example, but their reproductive behaviour can be altered to a point that affects nest initation patterns (Rotella et al. 1993; Pietz et al. 1993). Also, the transmitter and harness we used amounted to slightly more than 5% of the animal's body mass, which has been suggested as an upper limit for radio-tracking studies of flying animals (Aldridge and Brigham 1988).

That being said, we have several reasons to believe that telemetry and harness-style transmitters are valid techniques for studying incubation behaviour in this species. We rarely saw untagged female pipits in

flight, presumably because they spend much of their time tending the nest and foraging for ground-based prey (Harris 1933; Maher 1974). Also, 15 of 32 radio-tagged birds were able to carry out presumably normal incubation behaviour, and those that retained their transmitters and avoided predators were able to construct second or replacement nests. Moreover, the intervals we detected support estimates of renesting based on the frequency distribution of clutch intiation dates, which indicates that female pipits may only produce 1.5 clutches per year (Maher 1973).

There are also several advantages to gathering information on pipit incubation behaviour using radio telemetry. First, telemetry provides high-resolution data on the location and activity patterns of individual birds (see Sutter 1996). There is simply no other way to collect this information for birds such as pipits because they rarely fly and are virtually impossible to observe directly as they forage in dense grassy vegetation (personal observations). Second, the use of radio-tags leaves no doubt as to the identity of an individual, or which of the parents is tending the nest. Again, this information is difficult to obtain through direct observation because identifying leg bands are often hidden by the grass and the sexes of many grassland species are morphologically similar. Finally, the use of telemetry means there is no observer or blind to disrupt bird behaviour or attract predators.

The fact that we found renesting in pipits was not surprising. The breeding season for pipits at Matador can last 3 months, and individuals need only 25 days to raise a clutch to fledging (Maher 1973). Moreover, renesting has been reported in many other grassland species breeding at temperate latitudes (Beason and Franks 1974; Cartwright et al. 1937; DeSmet and Conrad 1991; With 1994) and in several congeners (Hendricks 1991; Askenmo and Unger 1986, and references therein).

The frequency of renesting in pipits may be affected by a combination of factors, including predation, energetic constraints and competition. The risk of predation can be extremely high for grassland birds (With 1994) with individuals breeding at Matador encountering nest predation rates as high as 69% (Maher 1973). The link between energy costs and renesting behaviour stems from the fact that birds generally need to invest large amounts of energy to breed at temperate latitudes, often directing resources away from their own survival and maintenance requirements (Martin 1987; but see Winkel and Winkel 1995). Finally, birds attempting to renest may have to compete for food supplies and nest sites, especially if breeding habitats are saturated (Wiens 1974, 1977). Our results confirm that Sprague's Pipits will attempt to maximize their seasonal reproductive output by renesting, despite the potential predation risk and energetic penalties.

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# Notes

## First Nesting of the Razorbill, *Alca torda*, in the Wolves Archipelago, New Brunswick.

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Mawhinney, Kimberley, and Dan Sears. 1996. First nesting of the Razorbill, *Alca torda*, in the Wolves Archipelago, New Brunswick. Canadian Field-Naturalist 110(4): 698–700.

Two pairs of Razorbills, *Alca torda*, were observed nesting on South Wolf Island in the Wolves Archipelago, Bay of Fundy, New Brunswick, during 1995. One pair had nested and successfully hatched one young in 1994 as evidenced by a hatched membrane from the previous year. Both pairs nested and successfully fledged one young each in 1995. This is the first nesting record for this species in The Wolves Archipelago. Other long-standing breeding colonies of Razorbills known to exist in New Brunswick are at Machias Seal Island and Yellow Murr Ledge.

Key Words: Razorbill, *Alca torda*, breeding, the Wolves Archipelago, Bay of Fundy.

Razorbills, *Alca torda*, breed in mainly small colonies throughout Atlantic Canada, with the bulk of the North American population centred in southern Labrador (Nettleship 1980). Of the five small colonies known to exist in the Maritimes, two are in New Brunswick at the southern limit of its breeding range (Erskine 1992). These occur at Yellow Murr Ledge, south of Grand Manan Island, and Machias Seal Island. Razorbills were recorded as occurring in The Wolves Archipelago as early as 1979 (MacKay and Bosien 1979) and non-breeding Razorbills were regularly observed in the area during the summer months between 1986 and 1993 (Kehoe, personal communication). On 14 May 1995, five Razorbills were observed flying around the southernmost tip of South Wolf Island in The Wolves Archipelago (44° 58′N, 66°55′W). On 22 May, two nest sites were located on the south-facing granite cliff of South Wolf Island approximately 10 m above the high tide mark and immediately adjacent to a recently established Black-legged Kittiwake, *Rissa tridactyla*, colony (Kehoe 1994).

One nest site had a single pale blue egg with reddish brown markings laid on the bare rock. Dried droppings and other bits of vegetation from the immediate vicinity were placed directly beneath it. This site also contained a leathery shell membrane, likely from a successfully hatched egg laid at this site in 1994. Razorbill pairs generally keep the same breeding site from season to season (Nettleship and Birkhead 1985) and shell membranes are indicative of successfully hatched eggs (Girard 1939). The Kittiwake colony on South Wolf was visited regularly during the summers of 1992 and 1993, and although Razorbills were observed in the area there was no evidence of nest sites (Kehoe, personal communication). This suggests that 1994 was the first year that breeding activity could have taken place.

These Razorbills were regularly monitored throughout the 1995 breeding season. By 27 May both nest sites contained eggs and were being incubated. On 9 July one pair was observed with a fully feathered pre-fledged chick and the other pair was still incubating an egg. By 22 July one pair had successfully fledged a chick and the other pair was observed with a fully feathered pre-fledged chick. By 18 August both pairs had successfully fledged their one young.

The North American Razorbill population was persecuted by humans through egging and hunting, and human occupation of many former nesting islands, up to the early 1900s. By this time its numbers were substantially reduced throughout its range and it was locally close to extinction (Bent 1919). Since that time, with better protection of nesting birds and the regulation of hunting under the Migratory Birds Convention in 1916, populations began to increase. While Razorbills do breed in Nova Scotia, the Gulf of Maine colonies make up the major portion of the Razorbills at the southern edge of their range in the eastern Atlantic. A. R. Locke (1971 Census of seabirds nesting in Nova Scotia May 18 to June, 1971. Unpublished Reprint Canadian Wildlife Service, Ottawa) reported a long

standing colony 51 pairs of Razorbills nesting in eastern Nova Scotia on colonies at Hertford/Ciboux Islands. Evidence of breeding at Pearl Island and at Margaree Island, in Nova Scotia was documented in 1971 and 1981, respectively (Erskine 1992).

Of the over 3000 islands in the Gulf of Maine six were known historically to support Razorbills, but almost nothing is known of the size of these former colonies (Drury 1973-1974; Korschgen 1979). With the exception of The Wolves Archipelago, five of these islands in the Gulf of Maine are currently breeding sites for Razorbills. Only two of these islands have been reported as nesting colonies in southern Canada.

Breeding records for the Razorbill colony on Machias Seal Island, in New Brunswick, date back to a single egg in 1886 (Squires 1945) and another single egg in 1922 (Pettingill 1939). However, Razorbills were not regularly observed on Machias Seal Island until 1937 (Pettingill 1939) and seventy-five pairs were reported in 1940 (Squires 1945). This population declined dramatically to 20 pairs in 1947 (Palmer 1949) and disappeared altogether in the late 1940s and early 1950s. Razorbills returned to Machias Seal Island by 1955 (Squires 1976), and they are presently estimated at 150-200 pairs (1995, K. Amey, personal communication). The long standing razorbill colony at Yellow Murr Ledge in New Brunswick has remained relatively stable over the past 80 years. Squires (1945) reported a colony of 150 birds in 1924 and Pettingill (1939) found 200 in 1935. They are currently estimated at 130 breeding pairs (1993, S. Kress, personal communication). It seems likely that Razorbills formerly bred more widely on islands in the Gulf of Maine and any evidence of breeding today may be the suggestions of re-occupation of former sites.

The first documentation of Razorbills, re-appearing in Maine was reported in 1952 on Matinicus Rock in outer Penobscot Bay (Drury 1973-1974) with most recent estimates reported at 40 nesting pairs in 1986 (Podolsky 1989). The second Maine site reported to be colonized was on Old Man Island. Drury (1973-1974) reported 40 individuals around the island in May of 1973 but was unable to confirm nesting. Korschgen (1979), however, estimated 10 nesting pairs on the island in 1974 and more recent estimates reported 26 breeding pairs in 1986 (Podolsky 1989). The third and most recent Razorbill colony established in Maine is located on Freeman Rock. Two nesting pairs were first reported in 1982; however, current numbers are not known (Podolsky 1989). Further prospecting by Razorbills has been observed at several former alcid colonies in Gulf of Maine (Drury 1973-1974), but gulls now occupy all of them, and gull interference may have inhibited or prevented recolonization (Nettleship 1972).

Whether or not Razorbills are re-establishing themselves in The Wolves Archipelago is unknown. This is the first nesting record for this species in The Wolves Archipelago, Bay of Fundy and is the third known breeding location for this species, near the southern limit of its range in New Brunswick. It adds to a short but growing list of recent occupation of breeding sites by seabirds in a region from which most species were extirpated a century ago.

In recent years, new records for breeding birds in the Gulf of Maine/Bay of Fundy indicate that several seabird species may be extending their breeding ranges and/or recolonizing traditional breeding grounds. In 1992, 12 pairs of Black-legged Kittiwakes were discovered breeding in The Wolves Archipelago (Kehoe 1994) and have increased to more than 100 pairs in 1995 (personal observation). Common Murres (*Uria aalge*) and Great Cormorants (*Phalacrocorax carbo*) recently established themselves as breeding birds on at least one site each, in the same general area, after nearly a century's absence (Erskine 1992). Further monitoring of the presence and activities of Razorbills in The Wolves Archipelago should provide insight into the dynamics of range expansion and/or recolonization of this species in New Brunswick.

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# Anomalies in the Eggs of Diving Ducks of the Genus *Aythya*

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We observed anomalies among the eggs of three species of diving ducks, including a shell-less egg outside the nest of a Canvasback (*Aythya valisineria*) and dwarf or runt eggs in the nests of Lesser and Greater scaups (*Aythya affinis* and *A. marila*). Shell-less eggs are rarely documented in wild birds. Runt eggs are more frequently documented, but we found no published record of their occurrence in scaups. Our observations indicate a frequency of occurrence of runt eggs in scaups of 0.10 %, similar to that reported for a number of other species.

Key Words: Canvasback, *Aythya valisineria*, Greater Scaup, *Aythya marila*, Lesser Scaup, *Aythya affinis*, shell-less eggs, runt eggs, dwarf eggs.

Impairment in the efficiency of the avian reproductive system may result in malformations of the egg (Romanoff and Romanoff 1949). Shell-less eggs, frequently produced by domestic birds (Romanoff and Romanoff 1949), are "little known" among wild species (Terres 1982). Abnormally small eggs, commonly referred to as dwarf or runt eggs, have been reported for a variety of species, both domestic and wild (e.g,. Romanoff and Romanoff 1949; Berger 1961; Rothstein 1973; Koenig 1980; Terres 1982; Mulvihill 1987) including at least one diving duck, the Bufflehead (*Bucephala albeola*) (Erskine 1971). Although runt eggs are not considered rare, there remains a need for reliable frequency data based on large samples of runt and normal eggs from wild populations (Mulvihill 1987).

While conducting studies of breeding waterfowl in the Yellowknife area (62°27′N 114°22′W) and on the nearby North Arm of Great Slave Lake, Northwest Territories, we observed anomalies among the eggs of three species of diving ducks.

On 2 June 1994, we observed a shell-less egg lying in the water next to the nest of a Canvasback (*Aythya valisineria*). The membrane had split at one end and the contents apparently leaked into the surrounding water. The membrane was leathery in appearance and had the texture of very fine sandpaper on the outside. It also had a small (about 1 cm) curled and tapered projection at one end. The nest contained four normal eggs which the female was incubating. This seemed a small clutch, as mean clutch size for Canvasbacks in the Yellowknife area was $7.05 \pm 0.16$ (S.E.) eggs (n=60, Fournier and Hines unpublished data).

Shell-less eggs may be otherwise normal, but are often abnormal both in size and shape (Romanoff and Romanoff 1949). This shell-less egg, although devoid of contents and thus flaccid, appeared normal in both categories. Terres (1982) stated that shell-less eggs had been reported for the Traill's Flycatcher (*Empidonax traillii*) and Common Grackle (*Quiscalus quiscula*). No further records were found in a review of literature for the period 1980-1994. Shell-less eggs may be more common than has been reported but, being very fragile, are likely most often destroyed before they can be observed (Romanoff and Romanoff 1949).

Romanoff and Romanoff (1949) concluded that the cause of shell-less eggs was either a failure of the glands in the shell-secreting portion of the oviduct or premature laying due to violent peristalsis, rather

than calcium starvation. However, the small clutch size in conjunction with the shell-less egg produced by this female could perhaps be considered indicative of nutrient (calcium?) limitation.

On 21 June 1994, we discovered a dwarf egg in the nest of a Lesser Scaup (*Aythya affinis*), which also contained eight normal eggs (Case #1). The dwarf egg measured 28.0 × 24.4 mm, whereas the eight normal eggs averaged 58.5 × 41.0 mm.

On 2 August 1994, we observed two dwarf eggs in the nest of a Greater Scaup (*Aythya marila*) (Case #2). There were no other eggs present in the nest. The dwarf eggs measured 37.5 × 28.6 mm and 38.1 × 28.4 mm. In comparison, Bent (1923) gave the average size of Greater Scaup eggs as 62.4 × 43.7 mm (n=180).

On 28 June 1995, we observed one dwarf egg in the nest of a Greater Scaup which also contained seven normal eggs (Case #3). The dwarf egg measured 44.7 × 31.8 mm, whereas the seven normal eggs averaged 63.2 × 43.9 mm. This dwarf egg occurred on the same island as Case #2 and could have been produced by the same (philopatric) female. On this same date, we observed a single runt egg in an incomplete scaup nest on an island approximately 200 m distant (Case #4). This egg measured 39.9 × 29.3 mm.

Given the dates of observation and presence of other normal-sized eggs, the dwarf eggs discovered in Cases #1 and #3 were undoubtedly products of first nesting attempts. The lack of any other eggs accompanying the dwarf eggs in Case #2, as well as the fact that the hen was still incubating in August, suggested that those eggs resulted from a renesting attempt. Case #4 may have been the product of either a first nest or a renest. With the exception of Case #4, all these runt eggs were being incubated at the time of discovery, as indicated by female behaviour, egg warmth, and amount of down in the nest.

During the course of our study we examined 5169 scaup eggs. This value is not easily divided between the two species because; 1) there is overlap in the size range of the eggs of the two species, 2) many nests were located without the female being observed, and 3) there appears to be a relatively high rate of parasitism between the two species on our study area (Fournier and Hines, unpublished data). Therefore, the data were pooled to provide an overall frequency of occurrence for scaups. The five dwarf eggs represented a frequency of occurrence of 0.10%. This lies within the range of values observed in other field studies, as reported by Koenig (1980) (0.02 to 0.15, average 0.08 percent — omitting woodpeckers) with the exception of Manning and Carter's (1977) observations for Canada Geese (*Branta canadensis*) (0.60 percent). Frequency of occurrence in studies of museum specimens is higher (0.23 to 0.54, average 0.36 - omitting woodpeckers) (Koenig 1980), undoubtedly for reasons outlined by Rothstein (1973) (e.g., selective collecting). We could find no previous published record of the occurrence of runt eggs in scaup.

The cause of dwarf eggs was succinctly summarized by Romanoff and Romanoff (1949) as "the result of temporary disturbance or accident, rather than a permanent abnormality or disorder of the reproductive organs." This explanation has been reiterated by others (e.g., Rothstein 1973; Koenig 1980) but, as Mulvihill (1987) pointed out, the causes of this phenomenon are not understood. Continued careful documentation of occurrences of dwarf eggs may eventually provide evidence for a more satisfactory explanation.

## Acknowledgments

Librarian A. Welch of the Department of Renewable Resources, Government of the Northwest Territories, conducted the search of recent literature for information on shell-less eggs. Librarian T. Fraser of Environment Canada provided assistance in obtaining much of the literature reviewed for the production of this note. J. Roosdahl provided able field assistance. A. J. Erskine and an anonymous referee provided comments on the draft manuscript.

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# Range Extension of the Hairy-tailed Mole, *Parascalops breweri*, in Northern Ontario

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Hecnar, Stephen J., and Darlene R. Hecnar. 1996. Range extension of the Hairy-tailed Mole, *Parascalops breweri*, in northern Ontario. Canadian Field-Naturalist 110(4): 702–703.

In July 1995 we observed and photographed a Hairy-tailed Mole (*Parascalops breweri*) near Agawa Bay in Lake Superior Provincial Park in Ontario (47°22′N, 84°38′W). This represents a new record approximately 45 km north from the previous peripheral location of Pancake Bay, Ontario (46°58′N, 84°42′W). Numerous tunnels of the species observed in the area suggested that populations were viable.

Key Words: Hairy-tailed Mole, *Parascalops breweri*, distribution, range extension, Ontario.

On 30 July 1995 we observed and photographed a Hairy-tailed Mole (*Parascalops breweri*) near the north end of Agawa Bay (47°22’N, 84°38’W) in Lake Superior Provincial Park (Figure 1). This sighting represents a new record of approximately 45 km north of the previous peripheral record of Pancake Bay, Ontario (46°58’N, 84°42’W; Anderson 1946; van Zyll de Jong 1983; Dobbyn 1994). The sighting also adds a new species to the mammal list of Lake Superior Provincial Park.

The Hairy-tailed Mole is readily distinguished from other moles that occur in Ontario by its short, hairy tail and lack of protuberances on the snout (Dobbyn 1994). The specimen we observed was recently deceased and near the exit of its tunnel at the edge of an abandoned logging road in the Awausee Trail area (topographic map 41 N/7, UTM 783485). The specimen was a female, uniformly slate grey in color, and 15.8 cm in total length (tail length 2.5 cm). We observed no apparent injuries on the body. We did not collect the specimen because we were in the area for other purposes and did not have means of preservation on hand. However, we photographed the specimen and submitted prints to the Canadian Museum of Nature (D. Campbell) and the Royal Ontario Museum.

The Hairy-tailed Mole occurs in the temperate Eastern Deciduous Forest of North America and ranges from Ontario and Québec southward into the mountains of Virginia and Tennessee (van Zyll de Jong 1983). It is now found mainly in second-growth hardwoods, edge habitats, and nearby meadows, where soils are light and moist, but well-drained (van Zyll de Jong 1983). The species is considered to be generally uncommon (van Zyll de Jong 1983). There are very few records of this species north of Lake Huron and east of Lake Superior in Ontario (Dobbyn 1994). The dearth of records from the area may indicate either genuine absence or rarity, or it may reflect the lack of thorough surveys.

Lake Superior Provincial Park has a modified continental climate, granitic bedrock, and rugged topography. The park is representative of the ecotone between the Boreal Forest and the Great Lakes-St. Lawrence Forest (Rowe 1972). The specimen and tunnels of the species were found in areas dominated by hardwoods such as Sugar Maple (*Acer saccharum*) and Yellow Birch (*Betula alleghaniensis*),

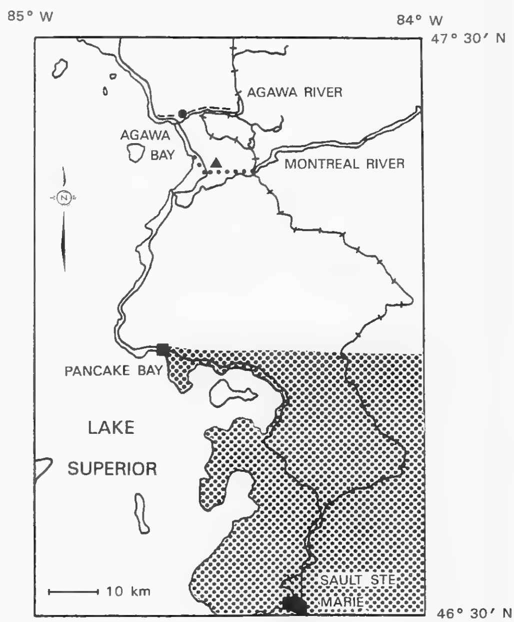


FIGURE 1. Study Area. Circle = Hairy-tailed Mole specimen and tunnels observed, Triangle = area of numerous tunnels, Square = former peripheral population. Solid line = Trans-Canada Highway, Crossed line = Algoma Central Railway, Dashed line = north wall of the Agawa Canyon, Dotted line = south boundary of Lake Superior Provincial Park. Shaded area indicates former species range within the study area (redrawn from van Zyll de Jong 1983).

trees typical of the Great Lakes St. Lawrence Forest. The location where we found the mole consists of approximately 70-year-old second-growth hardwood on sandy loam and gravelly soils. We observed numerous earthworms and other soil invertebrates under woody debris in the area. We observed a large number of surface tunnels, all in upland forest and well-drained locations south of the north wall of the Agawa Canyon in the Awausee Trail area and around Crescent, MacGregor, Mud, and Kenny Lakes.

Although Lake Superior Provincial Park was established in 1944, no previous records of *Parascalops breweri* for the park exist, and the species was not recorded in a small mammal survey conducted by the Royal Ontario Museum in the 1980s (Pasitschniak-Arts 1985). The only other mole in central Ontario is *Condylura cristata*, the Star-nosed Mole (van Zyll de Jong 1983). Although the ranges of both the Star-nosed Mole and Hairy-tailed Mole are broadly sympatric in Ontario, they would rarely be syntopic given the Star-nosed Mole's preference for wet habitats and that of the Hairy-tailed Mole for upland habitats (van Zyll de Jong 1983).

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# Field Anesthesia of Striped Skunks, *Mephitis mephitis*, Using Halothane

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Larivière, Serge, and François Messier. 1996. Field anesthesia of Striped Skunks, *Mephitis mephitis*, using halothane. Canadian Field-Naturalist 110(4): 703–705.

From April to August, 1993-1995, Striped Skunks (*Mephitis mephitis*) were captured in southcentral Saskatchewan, and immobilized using halothane. Eighty-one trials were performed on 47 adult skunks (11 males, 36 females) and seven juveniles (4 males, 3 females). An initial dose of 8 mL (n = 78) provided complete, acceptable, and inadequate anesthesia in 51 (66%), 19 (24%), and 8 (10%) trials, respectively. First awakening behavior, stand-up posture, and recovery occurred after a mean (SD) of 52 s (34 s), 71 s (28 s), and 87 s (15 s), respectively. Halothane provided rapid induction and recovery when used on Striped Skunks.

Key Words: anesthesia, halothane, immobilization, *Mephitis mephitis*, Striped Skunk.

Striped Skunks, *Mephitis mephitis,* have been anesthetized using injectable drugs such as sodium pentobarbital (Verts 1960), phencyclidine hydrochloride (Seal et al. 1970), a mixture of tiletamine hydrochloride and zolazepam hydrochloride (Larivière and Messier 1996), or ketamine hydrochloride (Rosatte and Hobson 1983). Most often, injectable anesthetics are administered by means of a pole syringe (Verts 1960) or following physical restraint (Crabb 1941). Solid-sided traps are now commercially available, and may be advantageous when working with skunks. Advantages may include reduction of scenting, reduction of stress levels in captured animals, and protection from weather. However, opaque traps do not permit the use of pole syringes (Verts 1960), and commercial traps do not possess a pushing barrier to force animals out of the trap for physical restraint (Crabb 1941). In contrast to injectable drugs, volatile anesthetics permit immobilization without physical contact, and can be used to immobilize animals captured in opaque traps.

Propane gas has been used for the anesthesia of Striped Skunks. However, its safety and effectiveness has not been detailed (Rosatte 1987), and the

TABLE 1. Levels of immobilization of Striped Skunks exposed to a single dose of 8 mL of halothane gas for various exposure times and trap types.

| | | Exposure time (min) | | | | |
|---|---|---|---|---|---|---|
| Trap type | Anesthesia | 2 | 3 | 4 | 5 | Total |
| Homemade wooden box | Complete | 11 | 9 | 6 | 2 | 28 |
| | Acceptable | 3 | 3 | 7 | 0 | 13 |
| | Inadequate | 0 | 0 | 4 | 0 | 4 |
| | Trials | 14 | 12 | 17 | 2 | 45 |
| Minnesota plasti-catch | Complete | 0 | 2 | 9 | 3 | 14 |
| | Acceptable | 0 | 0 | 0 | 1 | 1 |
| | Inadequate | 0 | 0 | 0 | 0 | 0 |
| | Trials | 0 | 2 | 9 | 4 | 15 |
| Tomahawk wire-mesh | Complete | 3 | 2 | 2 | 2 | 9 |
| | Acceptable | 2 | 0 | 2 | 1 | 5 |
| | Inadequate | 1 | 0 | 3 | 0 | 4 |
| | Trials | 6 | 2 | 7 | 3 | 18 |
| All traps | Complete | 14 | 13 | 17 | 7 | 51 |
| | Acceptable | 5 | 3 | 9 | 2 | 19 |
| | Inadequate | 1 | 0 | 7 | 0 | 8 |
| | Trials | 20 | 16 | 33 | 9 | 78 |

high inflammability of this gas makes it potentially dangerous to use. Halothane gas (M.T.C. Pharmaceutics, Cambridge, Ontario) has been used for the field immobilization of mammals such as Muskrats (*Ondatra zibethicus;* Blanchette 1989), weasels (*Mustela erminea;* Murphy and Dowding 1994), and American Martens (*Martes americana;* Herman et al. 1982). Its advantages include speed of induction and recovery, and ease in anesthesia procedures (Blanchette 1989). We tested the effectiveness of halothane gas for the chemical immobilization of Striped Skunks.

From April to July, 1993-1995, Striped Skunks were live trapped in the Thickwood Hills, south-central Saskatchewan (52°N, 107°W). Skunks were captured in (1) a mesh-wire live trap (model 204, 19 × 19 × 51 cm, Tomahawk Live Trap Co., Tomahawk, Wisconsin); (2) an opaque-sided plastic trap (23 × 23 × 60 cm, Minnesota Plasti-Catch, Mitlyng Development, Minnesota); or 3) a custom-built wooden live trap (19 × 18 × 71 cm). Traps were baited with canned sardines and checked daily, in the morning.

A wood box (25 × 25 × 53 cm) was made to cover mesh-wire traps to provide a closed environment for anesthesia. Because the edges of the box rested on the ground surrounding the trap during anesthesia, limited air penetrated the handling box and prevented an hypoxic condition. Wooden traps were ventilated through three 1-cm holes in the back, as well as a 0.5-cm space around the trap door. Similarly, ventilation holes in the door of the plastic trap allowed ventilation. All procedures were performed ouside to minimize exposure of humans to halothane (Short 1974: 17).

Halothane (8 mL) was applied directly under the door of wooden and plastic traps. For wire traps, halothane was applied to cotton balls and placed inside the handling box. Animals were left undisturbed for 2-4 min, after which their state of immobilization was qualified by their response to mechanical stimuli. State of anesthesia was classified as complete (no reaction to mechanical stimuli and no muscular resistance), acceptable (impaired movements and muscle resistance), or inadequate (no recumbancy, complete awareness, unimpaired movements). Anesthetized skunks were immediately removed from traps for handling. Inadequately anesthetized skunks were left in the trap for an additional 2-4 min, after which their state of anesthesia was reassessed. Failure to detect any sign of anesthesia after the second waiting period led to the second application of 8 mL of halothane.

Handling procedures often began by an injection of Telazol (Larivière and Messier 1996), or were limited to eartagging, sexing, and weighing. For most recaptures, halothane anesthesia was sufficient. Recovery from halothane was evaluated only for skunks not injected with Telazol.

Three characteristics of recovery were monitored: first awakening behavior (first non-stimulated head movements), stand-up posture, and complete recovery (unimpaired locomotion, gait normal). Recovery characteristics were calculated from the time of cessation of exposure to halothane. Excitation levels of captured skunks were evaluated before and after

application of halothane, and classified as low (limited movements in trap, no scenting) or high (panting, scenting, constant movements in trap).

Eighty-one trials were performed on 11 adult males (mean body mass = 2.60, SD = 0.42), 36 adult females (mean body mass = 2.06 kg, SD = 0.31, n = 33; Larivière and Messier 1996), and seven juveniles (4 M, 3 F; mean body mass = 1.00 kg, SD = 0.36 kg, n = 6) in the three different trap types (Table 1). Of these, 71, 6, and 3 trials involved use of a single, double, and triple application of halothane, respectively. One trial required five applications.

Seven of 20 trials in mesh-wire traps resulted in scenting during the covering of the trap, while only three of the 61 skunks captured in opaque traps scented. Similarly, skunks captured in wire traps were excited more often (11/20) than skunks captured in opaque traps (15/61).

Skunks were exposed to halothane between 2-5 min. Initial applications of 8 mL of halothane lead to complete, acceptable, and inadequate immobilization in 51, 19, and 8 trials, respectively (Table 1). Fifty-eight trials were followed by an injection of Telazol (Larivière and Messier 1996). Other trials (23/81) involved no use of injectable anesthetics. Following halothane anesthesia, skunks exhibited first awakening behavior quickly (mean = 52 s, SD = 34 s, n = 17), whereas stand-up posture and complete recovery occurred after 71 s (n = 14, SD = 28 s) and 87 s (n = 16, SD = 15 s), respectively.

Halothane applications seemed less effective in mesh-wire as compared to opaque traps. Additional stress is imposed on skunks captured in mesh-wire traps through the observation of nearby researchers, and scenting frequently occurs when covering wire-traps. Excited animals can develop life-threatening cardiac arrhythmias under halothane anesthesia (Sawyer 1982: 75), and excitement of skunks captured in wire-traps often appeared high. Therefore, the use of opaque traps is more suitable for handling Striped Skunks.

Halothane anesthesia on Striped Skunks was characterized by rapid induction and rapid recovery. The risk of overdose under uncontrolled field application of halothane presumably increases with prolonged exposure. Maintenance of halothane anesthesia over periods exceeding ~5 min requires a small concentration of anesthetic (1.5%; Sawyer 1982: 75) with the use of accurate and bulky delivery systems (Herman et al. 1982). Field conditions may not allow precise anesthesia equipment and procedures to be adopted. Nonetheless, we conclude that, regardless of sex or body mass, halothane is an adequate anesthetic for short (~1 min) handling procedures such as eartagging and recaptures.

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# European Beaver, *Castor fiber*, Pinned by a Felled Tree

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Kile, Nils B., and Frank Rosell. 1996. European Beaver, *Castor fiber*, pinned by a felled tree. Canadian Field-Naturalist 110(4): 706–707.

The death of an adult European Beaver (*Castor fiber*) caused by a felled tree in Southeast Norway is reported. The trunk fell on the beaver's tail pinning it to the ground.

Key Words: European Beaver, *Castor fiber*, Southeast Norway, felled aspen, *Populus tremula*.

On the morning of 21 November 1987 we found the remains of an adult European Beaver (*Castor fiber*) in Southeast Norway (58°39′N, 7°58′E). The animal apparently died after being trapped by a felled tree. It is uncertain whether this beaver, or another, actually felled the tree, though beaver reportedly most often fell trees alone (Wilsson 1971). Owesen (1979) reported that beaver run quickly to the side when a tree starts to fall. The felled aspen (*Populus tremula*) was about 40 cm in diameter at the base. The trunk had fallen across the Beaver's tail about 10 cm from the tip and 2 m from the stump of the tree. In an attempt to escape, the beaver had scraped a circular channel to the front and sides of where it lay. The carcass was frozen and still intact, suggesting that death had occurred recently. Beaver apparently cannot predict where a tree will fall. Wilsson (1971) observed that trees fall in all directions, though more frequently towards shore simply because they often lean waterwards, or have better developed crowns on that side.

North American Beaver (*C. canadensis*) have been reported trapped or killed by felled trees on four occasions (Table 1). Scotter and Scotter (1989) reported two, and Hitchcock (1954) reported one such death. These Beavers were dead when found. Ellarson and Hickey (1952) described the trapping

TABLE 1. A review of beaver (*Castor canadensis* and *C. fiber*) trapped or killed by trees.

| Source | Locality | Time of year | Age | Species | Part of body trapped | Status |
|---|---|---|---|---|---|---|
| Ellarson and Hickey, 1952 | Dane County-Iowa County, USA | October | Adult | *Castor canadensis* | Right hind foot | Alive** |
| Hinze, 1950 | Revier Großkühnau, Dessau, Germany | August | ? | *Castor fiber* | ? | Dead |
| Hinze, 1950 | Germany | ? | ? | *Castor fiber* | ? | Dead |
| Hinze, 1950 | Germany | ? | ? | *Castor fiber* | Right hind foot | Alive |
| Hitchcock, 1954 | Bristol, Vermont, USA | September | Adult | *Castor canadensis* | Head | Dead |
| Owesen, 1979 | Norway | ? | ? | *Castor fiber* | Hind foot | Alive*** |
| Piechocki, 1977 | Germany | Between 21 March – 7 June | Adults* | *Castor fiber* | ? | ? |
| Scotter and Scotter, 1989 | Sturgeon, Alberta, Canada | ? | Adult | *Castor canadensis* | Across the upper back | Dead |
| Scotter and Scotter, 1989 | Edmonton, Alberta, Canada | October | Adult | *Castor canadensis* | Across the shoulders | Dead |
| Stocker, 1978 | Kanton Thurgau, Schweiz | August | ? | *Castor fiber* | Right hind foot | Dead |
| This study | Aust-Agder county, Norway | November | Adult | *Castor fiber* | Across the tail | Dead |

* Two separate individuals
** Later released
*** Later killed

of a North American Beaver when the tree it had felled landed on one of its hind feet. This beaver was released unharmed. Four specific references to European Beaver being trapped or killed by trees have been reported previously. Hinze (1950) mentioned three incidences of beaver trapped under felled trees, of which one survived. Piechocki (1977) mentioned two and Stocker (1978) one incident. Owesen (1979) described how a beaver survived being trapped when a felled tree pinned its hind foot to the ground.

Most tree-felling by beavers occurs during autumn at the peak season for dam and den building, and six of eight animals were reported killed between August and November (Table 1). Only adult beaver were involved and only one (a male) had been sexed (Scotter and Scotter 1989). Felled trees were not considered as a significant mortality factor in North American Beaver (Hill 1982). What was once thought to be a freak event now appears to occur, although infrequently, with some regularity in Beaver populations in both Europe and North America.

## Acknowledgments

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# Common Eider, *Somateria mollissima*, Incubates Gadwall, *Anas strepera*, Eggs: A Case of Clutch Adoption Due to Human Disturbance?

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McAlpine, Donald F. 1996. Common Eider, *Somateria mollissima*, incubates Gadwall, *Anas strepera*, eggs: A case of clutch adoption due to human disturbance? Canadian Field-Naturalist 110(4): 707–708.

A female Common Eider (*Somateria mollissima*) was observed on a hatching clutch of Gadwall (*Anas strepera*) eggs on an island in the Bay of Fundy. This aberrant behaviour may have been related to eider egg predation by gulls, rates of which had been increased by human activity on the island.

Key Words: Common Eider, *Somateria mollissima*, disturbance, eco-tourism, Gadwall, *Anas strepera*, New Brunswick.

Associations between nesting Common Eiders (*Somateria mollissima*) and gulls (*Larus* spp.) have been widely studied (Bourget 1973, Götmark and Åhlund 1988, Swennen 1989 and references cited therein). Although Bellrose (1980) concluded that the larger gull species are the main predators of eider eggs and ducklings over most of the species' range, Swennen (1989) noted that eiders have evolved a number of behavioural adaptions that diminish the risk of gull predation on these life-history stages. Eider nest success has been reported to be higher within gull colonies than outside (Götmark and Åhlund 1988).

Perry (1982) documented cases in which Common Eider were observed taking over, and even defending from the original occupant, nests of both Herring (*Larus argentatus*) and Lesser Black-backed Gulls (*L. fuscus*). This nest stealing occurred prior to egg laying by gulls, but on one occasion a gull was observed to deposit an egg in a nest after being ousted, with the result that the eider incubated a mixed clutch. The outcome in this case was unknown. However, eiders have not been reported to incubate *and* eventually hatch the eggs of another species of bird, although eiders frequently nest in mixed-species

associations with larids and sometimes other ground-nesting waterfowl. Here, I document a case in which a female Common Eider appropriated the nest of a Gadwall (*Anas strepera*) containing a clutch of nine eggs. These eggs may have been incubated by the eider for a maximum of five days at the end of the incubation period, with the result that all eggs hatched and the ducklings were brooded by the eider. I suggest that this aberrant behaviour may have been the result of unintentional disturbance by naturalists visiting the island during a bird-banding programme.

On 19 June 1986 I discovered a Gadwall nest containing 10 eggs on Manawagonish Island, New Brunswick (45°12′ N 66°06′ N), an island of about 20 h 1.5 km offshore in the lower Bay of Fundy. Principal species nesting on the island include more than 4000 Double-crested Cormorant (*Phalacrocorax auritus*), several hundred Herring and Great Black-backed Gulls (*L. marinus*) and a few Great Blue Herons (*Ardea herodias*) and Common Eiders (Astle and McAlpine 1985). The Gadwall nest was 5 m into a thicket of 1.5 m high *Spiraea latifolia* in an abandoned field about 100 m from the water's edge. No parent bird was on the nest when it was discovered. As few Gadwall nesting records in New Brunswick were known, a single egg was collected as documentation (McAlpine et. al. 1988; NBM 5994). The egg contained a well-developed embryo, and I expected to find the remaining eggs had hatched or were pipping when I returned to the nest on 23 June.

At that time a female Common Eider was on the nest brooding seven ducklings while the last two struggled from the shell. The eider remained on the nest at my approach, and I watched her for about 1 minute. As I backed away, the bird left the nest, moved quickly through the undergrowth for about 30 m, and then took to the air. As the chances for survival of the young seemed diminished, and as I would not be returning to the island to monitor their fate, I retrieved the young. Three birds died within 72 hours; the remaining six were deposited at a local zoo, where one perished just prior to fledging, with the remaining five eventually released.

The observation reported here is likely the result of egg predation by gulls after the incubating eider was flushed from it's own nest by bird-banders; incubating female eiders are almost always on the nest during the day, although they may leave for short periods at dusk (Andersson 1975, cited in Götmark 1989). Bird-banding activities for gulls and cormorants in the days prior to the discovery of the adoption of the Gadwall clutch were responsible for three known incidents of gull predation on eider clutches near the Gadwall nest.

Paynter (1951) and Gilliland (1990) reported significant predation on eider eggs and ducklings by gulls on islands in the lower Bay of Fundy. Gilliland (1990) believed disturbance during field research on nesting eiders might be responsible. Dwernychuk and Boag (1972) attributed increased predation rates on duck eggs by gulls to disturbance by researchers. Likewise, Götmark and Åhlund (1984) noted that disturbance by field workers led to much higher predation rates on clutches of eggs in eider colonies when eggs were left exposed. Swennen (1989) attributed increasing eider nest success at a gull colony to reduced disturbance by researchers. It is clear that the presence of observers may increase predation on eider clutches, leading perhaps to unusual behaviour such as that noted here. In the past two decades there has been an increase in eco-tourism in the Bay of Fundy, with emphasis on whales and seabirds. Documenting incidents of aberrant behaviour of birds at nest sites, particularly when there are links to observer presence, may be useful in assessing the impact of possible eco-tourist activity on wildlife in the future.

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# Présence de la Puccinellie étroite, *Puccinellia angustata*, au Nunavik, Québec

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Cayouette, Jacques, et Marcel Blondeau. 1996. Présence de la Puccinellie étroite, *Puccinellia angustata,* au Nunavik, Québec. Canadian Field-Naturalist 110(4): 709–711.

Après avoir révisé les récoltes du Québec précédemment identifiées à la Puccinellie étroite, *Puccinellia angustata*, les auteurs rapportent maintenant les seuls spécimens authentiques de cette espèce pour cette province. Il s'agit de leurs récoltes faites à l'embouchure de la rivière Lacoudray (61°46'N – 72°35'W), dans la portion septentrionale du Nunavik. Un dénombrement chromosomique de $2n = 42$ a été effectué sur un individu provenant de cette station. Cette localité marque une extension d'aire de plus de 500 kilomètres vers le sud pour cette graminée du Haut-Arctique. Elle est comparée à *P. deschampsioides* et à *P. macra* à qui elle ressemble superficiellement. *P. angustata* devrait être ajouté à la liste des plantes vasculaires susceptibles d'être désignées menacées ou vulnérables au Québec.

With the elimination of specimens from Quebec that had previously been identified as Narrow Alkali-Grass, *Puccinellia angustata*, the authors now report the only authentic specimens of this species from the province. These were collected by them at the mouth of Lacoudray River (61°46'N, 72°35'W) in the northernmost part of Nunavik. A chromosome number of $2n = 42$ has been found on one specimen from that site. This locality represents a range extension of more than 500 kilometers to the south for this High-Arctic grass. It has been found to be distinct from the superficially related *P. deschampsioides* and *P. macra. P. angustata* should be added to the list of vascular plants likely to be listed as vulnerable or threatened in Quebec.

Key Words: Narrow Alkali-Grass, Puccinellie étroite, *Puccinellia angustata*, *P. deschampsioides*, Nunavik, Québec, chromosome number, range extension.

La Puccinellie étroite, *Puccinellia angustata* (R. Br.) Rand & Redf., est une Poacée circumpolaire du Haut-Arctique (Figure 1; Hultén 1968; Porsild et Cody 1980). Elle est mentionnée par Scoggan (1978) pour la Gaspésie et le nord du Québec. Selon cet auteur les mentions méridionales seraient des erreurs d'identification. Quant aux citations de Polunin (1940) et de Dutilly et Lepage (1951) pour le Nouveau-Québec, Scoggan précise que les spécimens de référence n'ont pas été vérifiés. Polunin (1940) inclut *Puccinellia vaginata* (Lange) Fern. & Weath. dans sa définition de *P. angustata*. Rouleau (*in* Marie-Victorin 1964) semble suivre cette opinion puisqu'il mentionne *P. angustata* pour le Québec et non pas *P. vaginata*. Toutes les récoltes de "*P. angustata*" *sensu* Polunin pour la région de la baie Wakeham que nous avons retracées ont été révisées à *P. vaginata* (Blondeau et Cayouette sous presse), mais le spécimen correspondant à la mention de "*P. angustata*" pour Port Burwell, au nord du Labrador, n'a pu être retrouvé. Une mention pour cette dernière région apparaît sur la carte de Porsild (1964) mais n'a pas été retenue par Porsild et Cody (1980). En consultant une carte inédite de Porsild (Cody communication personnelle), on retrouve une mention "Rousseau 1951" localisée un peu plus au sud sur la côte est de la baie d'Ungava, Nunavik. Le spécimen correspondant a été retracé (Ungava, poste de la rivière George, 9 août 1951, *J. Rousseau 1162*, QUE) mais il a été révisé à *P. laurentiana* Fern. & Weath. par Sørensen. Dutilly et Lepage (1951) citent *P. angustata* pour la région de la Pointe Louis-XIV, au sud de la baie d'Hudson (îlot à10 milles au nord-est du cap Jones: *Dutilly et Lepage 12789*); le spécimen correspondant retracé à QFA a été révisé à *P. pumila* (Vasey) Hitchc. par Sørensen.

Dans le cadre d'une étude floristique au Nunavik, Nouveau-Québec, Blondeau et Cayouette (sous presse) ont exploré en 1994 le bras sud-est du havre Douglas; près de l'embouchure de la rivière Lacoudray, les auteurs ont récolté des individus qui correspondent bien à la description de *P. angustata* (Sørensen 1953; Sørensen *in* Hultén 1968), aux récoltes authentifiées par Sørensen dans les herbiers CAN et DAO et à la description d'individus de l'Arctique canadien (McLachlan et al. 1989) sauf pour la taille qui est un peu plus grande (> 30 cm). La citation complète de la récolte du Nunavik est la suivante:

> Québec, Nunavik, [havre Douglas, bras sud-est], rivière Lacoudray, rive est, environ 61°46'N – 72°35'W – UTM: 18VXD274514, berge argileuse, 6-VIII-1994. *J. Cayouette et M. Blondeau C7914* (DAO), *Blondeau et Cayouette HD94264* (C, QFA, Herb. Blondeau).

En raison de leurs tiges dressées et de leurs panicules étroites, les individus du havre Douglas ressemblaient à *P. deschampsioides* T.J. Sørensen dont il existe des récoltes de la région de Salluit au Nunavik (Sugluk Inlet ou Anse Sugluk, 62°15'N – 75°28'W : *Dutilly 6980v* (QFA), *6980x* (CAN,

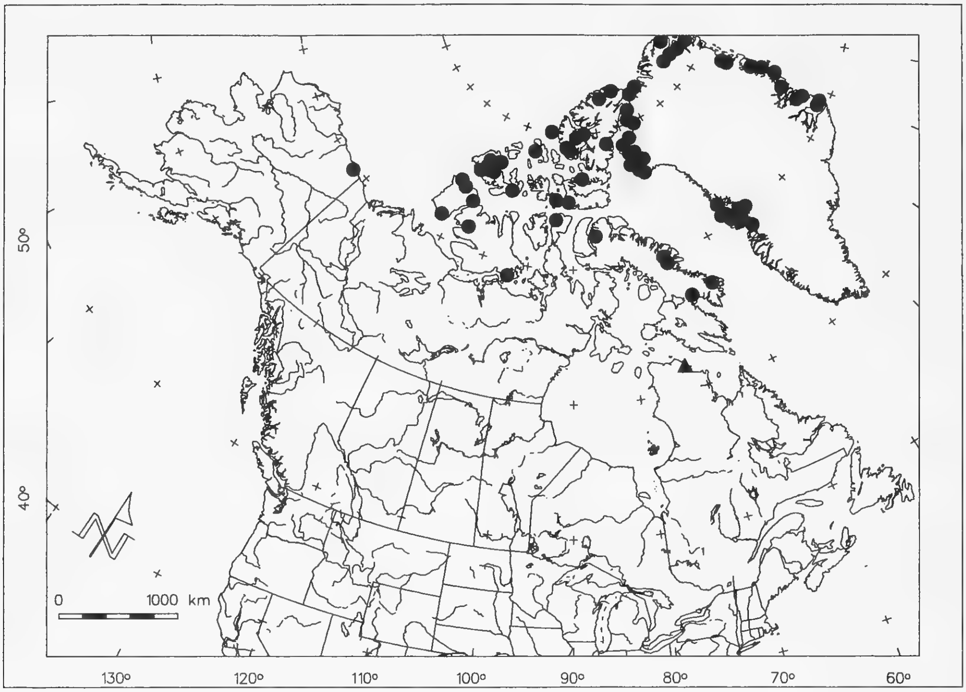


FIGURE 1. Répartition nord-américaine de *Puccinellia angustata*. Sources: Cercles - Porsild et Cody (1980), Hultén (1968); triangle - nouvelle station.

QFA), *6980y* (CAN), *Duman 2432* (CAN, QFA)); Sørensen (1953) lui-même citait la récolte de *Dutilly 6980x* qu'il avait authentifiée comme la seule mention de cette espèce connue à l'époque hors du Groenland.

*P. angustata* diffère de *P. deschampsioides* par les principaux caractères suivants mesurés sur notre récolte du havre Douglas (*P. angustata*) et sur les récoltes de Salluit (*P. deschampsioides*) : longueur de la glume supérieure (*angustata:* 2.9-3.2 mm vs *deschampsioides:* 2.0-2.5 mm), longueur du lemma (3.6-4.0 mm vs 2.5-3.2 mm), nombre de fleurons par épillet (3-5 vs 4-8), pubescence à la base du lemma (abondante vs dispersée); de plus la présence de longs cils à la base des carènes du paléa caractérise *P. angustata*, alors que ces cils sont moins longs et moins abondants chez *P. deschampsioides*. Bent Fredskild du *Grønlands Botaniske Undersøgelse* de Copenhague (*in litt.* 1995) confirme que notre récolte du havre Douglas ne correspond pas à *P. deschampsioides*.

Un dénombrement chromosomique effectué sur des mitoses racinaires provenant d'un individu de la population du havre Douglas (*Cayouette C7914-1*) a révélé $2n = 42$ chromosomes, le seul nombre connu jusqu'à maintenant pour *P. angustata* (Löve et Löve 1975). Par contre, le nombre de $2n = 56$ est le seul connu pour *P. deschampsioides* (Löve et Löve 1975).

*P. angustata* ressemble sous certains aspects à l'espèce boréale nord-américaine *P. macra* Fern. & Weath., surtout par son inflorescence étroite, par le degré de pubescence à la base du lemma et par les longs cils à la portion inférieure des carènes du paléa. Il s'en distingue par les caractères suivants mesurés sur *P. angustata* du havre Douglas et certaines récoltes de *P. macra* de la baie James (DAO): longueur de la panicule (*angustata:* 3-7 cm vs *macra:* 8-11 cm), longueur du lemma (3.6-4.0 mm vs 2.5-3.0 mm), nombre de fleurons par épillet (3-5 vs 5-6), couleur habituelle des épillets (violacée vs verdâtre), longueur du caryopse (1.8-2.0 mm vs 1.4-1.6 mm); de plus la nervure dorsale du lemma de *P. macra* porte fréquemment des acicules alors que celle de *P. angustata* est glabre. Il semble n'exister aucun dénombrement chromosomique connu pour *P. macra*.

À la rivière Lacoudray, *P. angustata* a été retracé à un seul endroit, soit un peu en amont de l'embouchure, à la base d'une berge argileuse, un habitat qui correspond à ce que rapportent McLachlan et al. (1989). Les panicules violacées, étroites et dressées de *P. angustata* contrastaient vivement avec les grosses touffes prostrées et glauques de *P. vaginata* qui croissait à proximité.

Cette extension d'aire de *P. angustata* est remarquable, du fait qu'il atteint rarement le sud du cercle

polaire, notamment en Amérique du Nord; il se retrouve maintenant à plus de 500 kilomètres au sud de la plus proche localité sur l'île de Baffin (Figure 1). Même si à première vue la présence d'une espèce du Haut-Arctique peut sembler étonnante à la latitude du havre Douglas, elle ne représente pas le seul cas connu pour cette région. Des espèces du Haut-Arctique comme *Deschampsia brevifolia* R. Br. et *Poa hartzii* Gand., ainsi qu'*Erigeron compositus* Pursh, une espèce arctique-alpine présente dans le Haut-Arctique, ont déjà été signalées pour le bras sud-ouest du havre Douglas, à quelques kilomètres du site de la rivière Lacoudray (Cayouette 1984).

*Puccinellia angustata* n'apparaît pas sur la liste des plantes vasculaires rares du Québec (Bouchard et al. 1983) ni sur la liste des plantes vasculaires susceptibles d'être désignées menacées ou vulnérables au Québec (Lavoie 1992). Comme il semble que notre récolte soit la première authentifiée au Québec, cette espèce devrait faire partie d'une prochaine version de la liste des plantes rares du Québec.

## Remerciements

Merci à Sue Porebski et à Walter Wojtas (DAO) pour la confection de la carte de répartition, à Walter Wojtas pour son assistance technique au dénombrement chromosomique, à William J. Cody (DAO) pour le prêt des cartes inédites de A. E. Porsild et ses commentaires sur le manuscrit, à Claude Roy (QFA) pour le prêt de spécimens, à Bent Fredskild (C) pour son expertise sur les *Puccinellia* du Groenland, à André Ouellet d'Ammuumaajuq Adventure (Kangiqsujuaq) pour les facilités de transport et à Harry Okpik notre guide inuit de Kangiqsujuaq.

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# Red Squirrel, *Tamiasciurus hudsonicus* — Short-tailed Shrew, *Blarina brevicauda,* Brief Interaction

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Nero, Robert W. 1996. Red Squirrel, *Tamiasciurus hudsonicus* — Short-tailed Shrew, *Blarina brevicauda*, brief interaction. Canadian Field-Naturalist 110(4): 712.

A Red Squirrel, *Tamiasciurus hudsonicus*, tussled briefly with a Short-tailed Shrew, *Blarina brevicauda*, beneath a bird feeder.

Key Words: Manitoba, Red Squirrel, *Tamiasciurus hudsonicus*, Short-tailed Shrew, *Blarina brevicauda*.

In the winter of 1995-1996, Red Squirrels frequently visited bird feeders at my Winnipeg home, one individual in particular aggressively driving away both other Red Squirrels and the much larger Grey Squirrels *(Sciurus carolinensis)*. By November 1995, only two Red Squirrels were present, one at each of our two main feeders. Unexpectedly, from the first snowfall of October 1995 up to the end of January 1996, Short-tailed Shrews were also visible. From our living room window, which faces our well wooded backyard, my wife and I watched shrews come out onto the snow regularly at five different sites. These places were far enough apart to suggest that different individuals were involved. On a few occasions, we saw two shrews out at the same time.

The fondness of Short-tailed Shrews for sunflower and other seeds has been pointed out earlier (Nero 1995). One shrew foraged on mixed birdseed beneath a feeder attached to a large spruce in front of our window. The tree lacks branches for several feet upwards, so we had a good view. Initially, I had scattered birdseed on the ground near the base of the tree to attract migrant sparrows and other birds; then, after it snowed, I cleared an area to expose the seed. The shrew, attracted by the seeds, kept coming out from burrows in the snow to feed, even in the daytime. I saw it as early as 05:00 h and as late as 22:00 h. Almost daily, especially beginning at about 15:00-16:00 h, it would come out into the open, feed briefly, then scurry back out of sight. Sometimes, it repeated this pattern for half an hour. I couldn't tell if it was just eating or taking seeds away to store, but its occasional appearance seconds later some distance away suggested that it was storing seeds. Occasionally, the shrew would crouch and feed for several minutes.

On 9 December 1995, at about 13:45 h, a sunny day with a temperature at -24°C, my wife saw a Red Squirrel tussling with the shrew in the food patch. The two scrambled about for a few seconds, then the shrew ran off over the snow, pursued by the squirrel which caught up with the shrew about 2 feet (ca 61 cm) away. Again there was a struggle, then, surprisingly, considering their size difference, the shrew once again escaped, darting down one of its several burrow openings. The squirrel then climbed back into the spruce tree. Apparently, no injury resulted to the shrew (or the squirrel!), for a day later we saw the shrew come out to feed as usual.

The carnivorous tendencies of the Red Squirrel, along with its habit of defending a food source, have previously been noted (Nero 1987, 1993; Taylor 1988; Sullivan 1991). Had the Red Squirrel been able to kill the shrew, if that was even its intention, it might have eaten it. The robust and aggressive nature of this venomous insectivore, however, make it an unusually tough and dangerous opponent. It seems more likely, however, that the Red Squirrel was simply defending its food source from a potential competitor. Given the notable scarcity of acorns in fall 1995, our squirrels seemed more aggressive and even desperate in their efforts to obtain food.

## Acknowledgments

Ruth Nero is thanked for taking note of this incident and describing it to me shortly after seeing it take place. Gordon G. Graham kindly typed the manuscript.

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# Changed Status of the Hooded Merganser, *Lophodytes cucullatus*, in the Yellowknife area, Northwest Territories

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Fournier, Michael A., and James E. Hines. 1996. Changed status of the Hooded Merganser, *Lophodytes cucullatus*, in the Yellowknife area, Northwest Territories. Canadian Field-Naturalist 110(4): 713–714.

Increased observations of Hooded Mergansers, *Lophodytes cucullatus*, have occurred in the Yellowknife area in recent years. These observations indicate that Hooded Mergansers now utilize this region during the post-breeding, moulting, and migration periods. The occurrence of paired birds in spring suggests the possibility of breeding. There are two plausible explanations for this increase, population increase and subsequent range expansion or displacement due to environmental disturbance.

Key Words: Hooded Merganser, *Lophodytes cucullatus*, Northwest Territories, increased numbers, changed status, moulting.

The breeding range of the Hooded Merganser encompasses the southern and central portions of most Canadian provinces, but the northern limits of its range are poorly defined (Godfrey 1986) and migratory movements, dispersal, and moulting distribution are largely unknown (Bellrose 1980, Dugger et al. 1994).

In summer and fall non-breeding or post-breeding birds occur northward of breeding areas across central and northern Canada and Alaska (Harper 1953, Mossman 1957, Nero 1963, Palmer 1976, Bellrose 1980, Hooper 1989). In British Columbia, the Hooded Merganser is distributed, in spring and summer, north to the Peace Lowlands and the Liard River drainage (Campbell et al. 1990). In the Yukon it is considered rare, indicating only one to three observations occur annually (Anonymous 1992). In Alberta, Hooded Mergansers were recorded as possible, probable, or confirmed breeders at five locations in the northern third of the province between 1987 and 1991 (Semenchuk 1992).

Historically, the Hooded Merganser has been considered rare in the Northwest Territories (Baird et al. 1884, MacFarlane 1908, Preble 1908). In the Yellowknife area it was classified as a rare summer transient (Bromley and Trauger 1981) based on observations of six individuals between 1962 and 1968. More recently, the Hooded Merganser has been classified as a migrant and summer resident in the mainland portion of the Northwest Territories (Sirois and McRae 1994). The assignment of this status was based largely on data presented here.

Many of the observations we discuss, including the largest groups for each year, are the product of random sightings. Therefore, the factor of increased observer effort as a partial explanation for our observations cannot be eliminated. However, some of these observations are the product of systematic surveys conducted by the Canadian Wildlife Service, since 1985, as part of a study of boreal forest ducks in the Yellowknife area. Thus, the increase has been substantiated with systematically collected data.

We observed Hooded Mergansers sporadically between 1985 and 1991 in the Yellowknife area, including sightings of lone males in May 1985, June 1989, and May 1990. Five Hooded Mergansers (four males and one female) were observed near Yellowknife in October 1990 and a pair was observed in May 1991.

In the summer and fall of 1992 increased numbers of observations of this species began to occur in the Yellowknife area, and continued through the spring of 1995. Observations of 91, 131, and 125 individuals, from a variety of locations around Yellowknife and the North Arm of Great Slave Lake, were reported in 1992, 1993, and 1994 respectively. Although some of these may have been repeat observations of the same birds, these numbers represent a significant increase over the next highest yearly total of six individuals, observed in 1990.

The largest single groups observed were: approximately 35 (sex ratio unknown) in 1992, 46 (40 males and six females) in 1993, and 58 (42 males and 16 females) in 1994. All of these large groups were observed in the fall. Hooded Mergansers were observed as late as 22 October in 1993.

Observations of two flightless males in July 1992 and a single moulting male in June 1993 provided the first evidence of a probable moult migration of this species to the Yellowknife area. All other observations were of birds in breeding plumage and/or capable of flight.

Although most of our observations occurred in late summer and fall, increased observations in spring and early summer began to occur in 1994 and continued in 1995. Between 16 May and 1 June 1994, 23 individuals were observed, including five pairs, whereas in 1995, 26 individuals were observed between 10 May and 11 June, including at least five pairs. These numbers represent a substantial increase. Prior to

1994, the highest total number of Hooded Mergansers observed in May and June of any single year was two, which occurred in 1962 (two lone males), 1991 (one pair), and 1993 (two lone males). The earliest recorded arrival of this species in the Yellowknife area occurred on 10 May 1995.

Increased observations of Hooded Mergansers near Yellowknife may be indicative of an overall population increase and/or range expansion of the species. We could find no direct evidence to support this hypothesis but this is not surprising. A population increase would be difficult to detect, as Hooded Mergansers are generally not specifically identified, but grouped with all other merganser species, during surveys designed to detect waterfowl population trends. However, an apparent population increase and range expansion in the northwestern portion of the range was reported previously by Palmer (1976), and a recent review of current knowledge for this species (Dugger et al. 1994) suggested that populations are possibly increasing over much of the range.

Our observations could also be a result of a change in migrational or moulting distribution, perhaps related to loss of suitable habitat in other areas. One major environmental perturbation which could explain a northward shift in distribution of this species during the breeding and/or post-breeding seasons is recent increases in forest exploitation in northern portions of the western provinces. The Hooded Merganser is closely tied to forested wetland systems (Dugger et al. 1994) and a number of authors have related population declines in this species with deforestation (Phillips 1926, Salt and Salt 1976; Dugger et al. 1994). Displacement of birds (declines) in one region may result in increases elsewhere.

Our observations add to the knowledge of this species in the northern portions of its range. First they indicate that an increasing (but probably small) portion of the population migrates as far north (at least) as the Yellowknife region in spring and summer (c.f., Dugger et al. 1994). Further, some of these birds remain to moult and apparently utilize the area for staging prior to fall migration. Finally, paired birds now occur in the Yellowknife area at the appropriate time and in sufficient numbers to suggest the possibility of breeding, although this seems unlikely given the currently recognized breeding range of the species (e.g. Palmer 1976, Bellrose 1980, Godfrey 1986; Dugger et al. 1994, but see Semenchuk 1992).

## Acknowledgments

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# Extralimital Occurrences of Willow Ptarmigan, *Lagopus lagopus*, in Maine

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Applegate, Roger D. 1996. Extralimital occurrences of Willow Ptarmigan, *Lagopus lagous*, in Maine. Canadian Field-Naturalist 110(4): 715.

Five previous Willow Ptarmigan records in Maine, south of the usual species range, from 1892 to 1988, are summarized. A new record, from Brooks, Waldo County, taken in May 1990, is documented with a specimen.

Key Words: Willow Ptarmigan, *Lagopus lagopus*, distribution, Maine.

The Willow Ptarmigan, *Lagopus lagopus L.*, winters primarily on the southern edge of the species breeding range, in the arctic tundra throughout the Palearctic and Nearctic, including the British Isles and Newfoundland . It is reported to wander casually south in winter to Montana, North Dakota, Minnesota, Wisconsin, central Ontario and Maine (AOU 1983).

Records from Maine include a Willow Ptarmigan in winter plumage shot in Kenduskeag, Penobscot County (44° 50′N, 68° 75′W), on 23 April,1892 (Merrill 1892). Other reports that are considered reliable are for T6 R7 WELS, Penobscot County (46° 09′N, 68° 38′W), 1951 [Dolley 1951, reported by Vickery (1978), as Sherman Mills], Freeport, Cumberland County (43° 55′N, 70° 05′W), 6 December 1954; Bailey Island, Cumberland County (43°40′N, 70°00′W), May 1977 (Vickery 1978); and Petit Manan National Wildlife Refuge, Washington County (44° 25′N, 61° 54′W), April 1988 (Widrig 1989).

In May 1990 an adult male in winter plumage was taken captive in Brooks, Waldo County (44° 32′N, 69° 07′W), Maine. The ptarmigan later died in captivity and was turned over to Maine Department of Inland Fisheries and Wildlife officials. The specimen was submitted to the Wildlife Collection, Department of Wildlife Ecology, University of Maine, Orono, Maine 04473.

Willow Ptarmigan are considered to be cyclic with an approximate 10-year periodicity of peaks and lows (Johnsgard 1973). Keith (1963: 57) charted data (largely from Williams 1954) on ptarmigan population peaks and found an 8-10 year grouping of peaks. The Maine occurrences of Willow Ptarmigan in 1892, 1951, 1954, 1977, 1988, and 1990 may be related to these peaks.

Some populations of Willow Ptarmigan are considered migratory and this dispersal may be the result of high ptarmigan densities on the breeding range (Watson and Jenkins 1964). Territorial defence from February to May results in dispersal of excess non-territorial ptarmigan in the population (Mossop 1988). This could account for the preponderance of records of ptarmigan south of the breeding range during April and May.

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# News and Comment

## *Froglog:* IUCN/SSC Declining Amphibians Populations Task Force

Number 19, November 1996, of *Froglog*, the newsletter of the Declining Amphibian Populations Task Force of the World Conservation Union's Species Survival Commission, contains items on The Ghost of Pesticides Past? [evidence of persistant anthropogenic residues in certain Great Lakes basin frog populations], The Amphibians of Bangladesh, SSAR/DAPTF Symposium Report, Amphibians Under Pollution Impact in Ukraine, Amphibian Decline and Environmental Alterations, Ecosystem Breakdown in Paraguay, Green Frogs Exploited in Former Yugoslavia, Froglog Shorts, Publications of Interest.

*Froglog* is available on request from John Wilkinson, Department of Biology, The Open University, Walton Hall, Milton Keynes, MK7 6AA, United Kingdom ** Telephone: 01908 (44 1908 if ex©UK) 652274 ** Fax: 01908 (44 1908 if ex©UK) 654167 ** e©mail: DAPTF@open.ac.uk. *Froglog* can also be found on the World Wide Web at the following URL: http://acsinfo.open.ac.uk/info /newsletters/FROGLOG.html

Francis R. Cook

## *Recovery*: An Endangered Species Newsletter

The Fall 1996 issue of this newsletter published and distributed by the Canadian Wildlife Service, Environment Canada, has 12 pages. Although an ISSN number is given (0847-0294), neither volume or issue number appear. On page 7 the Coordinator is given as Chuck Dauphine, and editing and design credited to West Hawk Associates. Copies are free. There is no indication intended frequency of publication, but presumably it is at least twice a year (see previous notice in News and Comment *The Canadian Field-Naturalist* 110(2): 549). A french edition is available under the title Sauvegarde. For subscription send name, address, and language of choice, to *Recovery*, Canadian Wildlife Service, Environment Canada, Ottawa, Ontario K1A 0H3.

This issue's contents are: Broadening the scope of recovery [greater public participation and emphasis on ecosystem management] (Chuck Dauphine); Recovery Watch — Garry oak ecosystems under siege (Erich Haber, Chair, COSEWIC) — Scotland's national emblem threatened in Canada [Pitcher's Thistle] (Anwar Mann, Department of Plant Sciences, University of Western Ontario) — COSEWIC Update [Committee assesses first mollusc: Eelgrass limpet]; Saving the loggerhead shrike (condensed from a proposal by the Avian Science and Conservation Centre located at McGill University); RENEW Update: A new home on the range [Hook Lake bison calves to foster healthy Northwest Territories herd] (Cormack Gates, chair, Wood Bison Recovery Team); CITES considers turtles, bison for 1997 [proposed additions to Appendix II are the softshell, snapping and map turtles, transfers from Appendix I to II of the North American gyrfalcon population, and Canadian authorities are considering the preparation of a proposal to transfer the wood bison from Appendix I to II to allow trade in farm-bred animals] (Charles Dauphine); Ranking: A Proposal): A new designation system [an outline distributed at the national endangered species workshop in June in Toronto suggests new Red, Yellow and Green and Status Undetermined lists based on seven simple criteria] (Bill Harper, Ray Halladay, B.C. Ministry of Environment, Lands and Parks; Gordon Court, Steve Bechtel, Bill Hall, and Bob Andrews, Alberta Department of Environmental Protection); Editorial — Pigeonholing Nature [on the value of status designation even for peripheral species] (Chris Shank, Department of Resources, Wildlife and Economic Development in the Northwest Territories).

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# Book Reviews

## Zoology

### Polygyny and Sexual Selection in Red-winged Blackbirds

By William A. Searcy and Ken Yasukawa. 1995. Princeton University Press, Princeton. xviii + 312 pp., illus. Cloth U.S. $55; paper U.S. $29.95.

The August Krogh Principle states that for every question in biological research, there is at least one species that is ideally suited to study. When it comes to polygyny and sexual selection in birds, few species can rival the Red-winged Blackbird as an "August Krogh" species. Not only is it one of the most polygynous of all bird species, it is also widespread in North America and it breeds in open habitats where capture, nest finding, and direct observations are easy. Consequently, "redwing" behaviour has been studied in many places by many people (a good proportion of which are Canadian). This book is an excellent review of the extensive body of research carried out so far on redwing reproductive behaviour, with a discussion of how results fit with current views of polygyny and sexual selection.

Chapter 1 is an introduction to mating systems and sexual selection. Chapter 2, on parental care, tells us that males are mostly responsible for defence against predators, while females do most of the food provisioning. Chapter 3 describes the male territorial behaviour. Chapter 4 examines the various factors that affect female reproductive success. Avoidance of predation, by means of strategic nest location or guarding by the male, seems paramount. Chapter 5 shows where females choose to settle, based on various territory attributes; surprisingly, the number of females already present on the territory does not seem to matter. Chapter 6 collates the previous chapters in a test of various models to explain the maintenance of polygyny in redwing populations. It wisely uses an approach where alternative models are first falsified before support for the remaining model is provided. Here as in the rest of the book, more weight is given to experimental, rather than correlational, evidence.

Chapter 7 turns to sexual selection and the extent to which we can see it operating in present populations (not very much, it turns out). Sexual selection was still a potent force in the past, and chapter 8 presents the evidence that many male traits, most notably epaulets and song, are the adaptive result of sexual selection. Chapter 9 extends this adaptationist treatment to females and their behaviour in a polygynous system. Chapter 10 recapitulates the conclusions from the different chapters, and compares redwings with other polygynous birds.

The writing style is clear, with precise wording. Topics are presented in a smooth logical order, and in a cogent way. In places where evidence is ambiguous, the authors give their opinion about the most valid interpretation, but they never fail to present the alternatives. Each chapter ends in a conclusion that summarizes the main findings while pointing to future research. (There is still room for research in this busy field, if only because some interpretations are based on negative results, which need to be replicated to increase statistical power.) The authors are both very active in redwing research, and they seem to benefit from regular contact with other heavy hitters, as evidenced by the inclusion of some unpublished results and personal communications. An impressive 435 references are listed.

This book may be too specialized for the field naturalist, notwithstanding the fact that almost all studies on redwings are conducted in the field. However, the book is a must for students of polygyny and sexual selection; in fact, every professional ornithologist should have it, given that redwings have provided many of the textbook examples on which our views of polygyny and sexual selection in birds are based. August Krogh would approve.

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### Artificial Nest Structures for Ospreys: A Construction Manual

By P. J. Ewins. 1994. (Aussi disponible en français). Canadian Wildlife Service, Toronto. 39 pp., illus. Free.

This is a publication of potential interest to hand-skilled field naturalists. Indeed, this concise and well-illustrated construction manual was written primarily to encourage and help people construct, install, and maintain artificial nest platforms for Ospreys. Designs presented are those deemed best suited to habitats found in Canada but are by no means restricted to those, as evidenced by the large proportion of the designs depicted that were developed for habitats found in the United States.

Site selection considerations and general notes on construction are presented in point form, as a preamble to descriptions of artificial nest platforms. Here, proximity of such platforms to sensitive commercial interests sites such as fish ponds and pisciculture stations would be a worthwhile addendum to the manual's site selection considerations.

The majority of nest platform designs are grouped under single pole, tripod/quadrapod, or power line structures. Because installation of the latter structures requires significant assistance from utility personnel, such information should be of rather limited value to most naturalists. Nonetheless, there still remains an array of thirteen nest platform designs for the more typical field naturalist to choose from. Most types of platforms are depicted by means of a self-explanatory diagram and a complete list of materials is provided as well. Although diagrams vary in quality, important details always remain discernible. I found only one minor typographical error in the manual. The diagram of the optional inspection step for the Sanibel Tripod is referred to as Figure 13 instead of Figure 11 on page 17. As a biologist, I wished that some estimates of manpower and construction costs as well as information on the relative durability and vulnerability to vandalism of the main types of nest platform structures would have been provided. Such details might be obtainable through raptor organizations listed at the end of the manual.

This manual should prove particularly useful to personnel working for raptor organizations, wildlife agencies, and power utilities as well as to naturalists who want to play a more active role in Osprey propagation and those summer cottage owners who asked for the installation of a nest platform within sight of their dwelling but were placed on waiting lists.

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## Sibley Fishes

By S. A. Stephenson and W. T. Momot. 1994. Occasional Paper No. 15, Centre for Northern Studies, Lakehead University, Thunder Bay. iv + 133 pp. illus. $10.00.

*Sibley Fishes* is an intriguing title which perhaps needs some explanation. Sibley is the name of the peninsula jutting out into Lake Superior just east of Thunder Bay. Habitat on the peninsula was protected by the creation of Sibley Provincial Park in 1944. The park, now known as Sleeping Giant Provincial Park, protects a remnant of the original flora and fauna, including some White Pine forest.

This attractive small book has two main purposes: to provide a guide to the fish fauna of the park and to record present distribution so that changes may be recognized. It does both tasks well.

It begins by describing the area and the methods used to sample the fish community. Various factors that influence distribution are considered, especially the ecological requirements of fishes and the geological processes that have limited or aided their dispersal. Events since the retreat of the last Wisconsin glacier, about 9700 years ago, and those associated with draining of glacial lake Agassiz determined fish distribution on the Sibley peninsula. Problems today concern preservation of the naturally established fish communities from deliberate or accidental introductions and from undue fishing pressure.

The body of the book consists of brief descriptions of each of the 36 species recorded within the park. Each description is accompanied by an accurate sketch showing the form, fin placement, scale texture, and contour pattern. A map shows the streams and lakes where each species has been recorded.

As well as its obvious educational value, there is a third purpose to the book which should interest readers of *The Canadian Field-Naturalist.* This is to stimulate debate about conservation of aquatic resources within parks. We allow, even encourage, sports fishing in our parks, while we object to all other forms of exploitation. Why do we accept this illogical practice with its risks of introductions of exotic species for put-and-take fishing, introductions of parasites and diseases, and the danger of destabilising established native fish communities? The authors do not think we should ban fishing in parks but seem ambivalent about it because of the risks. Arguments for allowing the practice to continue are that it is a valid outdoor experience which pays handsome dividends in creating a love for the outdoors, promotes a conservation ethic and establishes a group of unpaid, wise watchdogs, keeping their eyes on the state of the aquatic environment.

An unresolved problem associated with banning fishing in parks is dealing with the question: what good are the fish since they are generally invisible unless caught? In this respect, to realise the second purpose of the book the authors (page 9) invite persons collecting specimens in the park to share the species distributional information with them, which suggests fish sampling be allowed in the park for scientific reasons.

It seems to me it would be best to treat fish like the rest of the flora and fauna and allow only observation. This can be done by promoting snorkelling, underwater photography, or by the use of glass bottomed boats. Providing the fish are not trained to appear at feeding sites, as occurs in some places, this

use of fish in parks should not alter natural communities and undisturbed aquatic communities should be one of the assets of parks.

This book is likely to appeal most to park visitors and residents of northwestern Ontario.

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## The Rise of Fishes: 500 Million Years of Evolution

By John A. Long. 1995. The Johns Hopkins University Press, Baltimore and London. 223 pp. 352 illus. Cloth U.S. $49.95.

*The Rise of Fishes* is a magnificent book, written by the Curator of Vertebrate Palaeontology at the Western Australian Museum, Perth, Australia. It provides a chronology of fish-like vertebrates from their origins to the present day. It explains how they learned to swim, manipulate and consume large prey, respire efficiently in water and in air, and how the organ systems of their bodies evolved. It is written from the perspective of someone who lives and works near the centre of some of the action, Gondwanaland, perhaps the cradle of fish evolution. The author knows many of the fossils first hand and has discovered and described enough of them to be able to write about them with confidence and authority.

The story begins with the earliest evidence of life on earth and a description of the fossilization process, evolution, continental drift and the geological time scale. The origins of fish-like vertebrates are considered next, along with their near-vertebrate relatives and bone, the characteristic vertebrate tissue. Then follow chapters on the Agnatha, Chondrichthyes, Acanthodii, and Placoderms. The origins, classification and diversity of each of these classes of vertebrate is presented in an interesting and lively way. The latest finds, many from Australia and China, are included. The author has the skill to make these ancient fishes seem real and alive. The extraordinarily good, coloured photographs of the actual fossils help, as do the many diagrams and illustrations of the fishes. What I liked about these chapters was the feeling, after reading them, that I knew something about the inhabitants of the ancient seas and freshwaters.

The bony fishes, Class Osteichthyes, include almost all living fish species and a lot of fossil representatives. I liked the description of the advantages these fish acquired from their teeth, bony scales, skeleton, and lungs, which became the hydrostatic organ, and their fins. I also liked the picture of them struggling to survive amongst the other more heavily armoured Devonian predatory fishes. The competition was apparently worth it for their descendants radiated out to fill almost every aquatic habitat on earth and gave rise to the immense variety of bony fish we know today.

The most successful group, the Actinoptergii, are traced from their origins in the Devonian from which deposits a variety of "palaeoniscoids", including genera from the tropical Late Devonian Gogo reefs of Western Australia, are described. Radiation of the group is followed through the Mesozoic with a selection of fossil fish, many from Australia, that were contemporaries of the great reptiles. Finally, in the late Cretaceous and through the Cenozoic., we get a glimpse of ray-finned fish diversity from the fine fossil beds of Brazil (Santana formation), USA (Green River, Wyoming), and Italy (Monte Bolca).

Lungfishes get extensive treatment with a view of Devonian diversity, a good treatment of their dentition, feeding ecology, and the origin and use of lungs. The Crossopterygians are likewise given thorough treatment, with emphasis on the Coelacanths. In this group it has been possible to check deductions from fossils against observations on the only extant member, *Latimeria chalumnae,* discovered off the coast of South Africa in 1938. John Long's sense of humour shines through when relatives of the Coelacanths are labelled fat-headed, beady-eyed predators (Porolepiformes) and, one of them, a fossil from Quebec, is named *Quebecius quebecius.* He comments, "where else with a name like that?" Illustrations of other relatives, the dagger-toothed fishes, Onychodontiformes, and the giant killers, Rhizodontiformes, are life-like to the detail of blood gushing out of prey impaled on their teeth.

The greatest step in vertebrate evolution, the move onto land, provides a climax to the book. It is described eloquently, logically, and with a sense of excitement and discovery. Like a good detective story, the plot should not be revealed until all the clues have been considered. The book comes to a fascinating and somewhat unexpected end.

I thoroughly recommend *The Rise of Fishes* to anyone with any interest in fish or vertebrate palaeontology. The more than 300 beautiful illustrations are worth the price of the book alone. They are colourful, reflecting the brilliant colours of most of Australia's present ichthyofauna. Would they have been so bright if they had been prepared by a Canadian? Perhaps not. This book was badly needed to make more generally known many new discoveries and to provide a counter balance for popularity of the dinosaurs. The real action was earlier. Read this book and discover for yourself.

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## Masters of the Ocean Realm: Whales, Dolphins, & Porpoises

By John E. Heyning. 1995. University of British Columbia, Vancouver. 112 pp., illus. $24.95.

When I was researching the East Coast whale watching industry for a federal government report, several of the operators I interviewed told me that their client's knowledge had changed dramatically in the last few years. It was no longer possible to satisfy them with a boat ride and a few sightings of big black shapes as clients now demand much more. The increase in awareness and interest in whales has been promoted by many fine new books and television programs. Most recently these books have tended to be more specialised accounts of single species and groups of whales or more detailed field and site guides. This new contribution reverses that trend and goes back to the most fundamental basics. Indeed, in many ways it is a book on the basics of mammal, and not just whale biology. A non-biologist could read this book without difficulty and, with reasonable effort, could gain an understanding of many of today's environmental issues.

The author begins by describing what a whale is (and is not) and gives some of the remarkable facts that hold us in awe. To illustrate and clarify important points he uses diagrams, charts, drawings and photographs. For example, he has used a drawing of a dolphin, followed by a diagram of the same dolphin to explain the skeletal structure. Similar outline and skeleton drawings of a dog and a human follow to show the relationship between the species. Each group of arm bones is colour coded to make these associations easier to follow. To capture special ideas that are peripheral to the flow of the text he has included inset boxes. His first use of this device is to explain parasitism in general and the particular parasites some whales carry.

Heyning uses an inset in his chapter on whale evolution to outline the major points of general evolutionary theory. This complements his account of the development of whales from small hoofed land mammals to giants of the sea. In describing the life of a whale he informs the reader of such whale traits as filter feeding with baleen, deep diving without the bends, sonar and echolocation, and the physical acts of spyhopping, lobtailing, and breaching. As well, he also covers more generic concepts such as intelligence, the food pyramid, and migration.

The chapters on conservation and research summarize the problems, needs, and status as these topics relate to whales, dolphins, and porpoises. He also provides the reader with a sense of these issues as they relate to our world in general. For example, the latest techniques in DNA fingerprinting, satellite tracking, photo-identification, and population census methods are covered with great simplicity and clarity. The author is primarily concerned with the application of these techniques to whale research but as they are more widely used in scientific investigations the reader is introduced to their general application. The first and last chapters of the book cover the relationships, both real and mythical, between people and whales. While these are described without an overlay of sensational emotion they leave us with a clear sense of our responsibilities for the whales and other creatures; responsibilities created by our own misuse of the world in which we live.

The text begins with very straightforward language and anybody from teenager to a senior will have no difficulty reading this book. The author progressively introduces scientific expressions as they are required and explains each one in simple terms. Once introduced, he continues to use the new term for the rest of the text, so the language becomes a little more complex as you progress through the book. The combination of readily understandable text and top rate illustrations make this book a winner for me. It is ideal for anyone newly interested in whales and other marine mammals or is about to go on their first whale watching trip. There is enough information to make a trip more rewarding but not enough to give information overload. However, the book is not, and is not meant to be, an identification guide as this type of material should be provided by the trip operator or one of the field guides dedicated to whales.

This book would be an ideal gift for a budding naturalist of any age. Teachers could also use it effectively as it is such an excellent introduction to many aspects of biology that uses a fascinating group of animals as its core. I have been studying whales for over 20 years and I have read many books on these mammals. Despite the basic nature of this new addition to whale literature I did learn something new and I had some long-unused segments of my memory dusted off and updated. For whatever reasons you choose you will not go wrong in buying this fine book.

ROY JOHN

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BOTANY

## A Checklist of Vascular Plants for Bruce and Grey Counties

Compiled by Bruce-Grey Plant Committee. 1995. 41 pp. Available from Own Sound Field Naturalists, Box 401, Owen Sound, Ontario N4K 3T1 or The Saugeen Field Naturalists, Box 20156, Hanover, Ontario N4N 3T1. $5.00 + $1.00 postage and packing.

Checklists of the vascular plants of any region are always most useful for visitors and the local inhabitants interested in what is growing around them. This checklist for Bruce and Grey Counties, which includes all of Bruce Peninsula (but excludes Keppel, Sarawak, and parts of Derby Townships of Grey County), is an excellent one. It includes 1420 taxa (species, subspecies, and hybrids) representing 134 families.

The list is divided into three groups: Ferns and Fern Allies, Conifers, and Flowering Plants. The latter is again divided into Dicotyledons and Monocotyledons. Within each of these groups, the families, genera, and species are listed alphabetically, followed by a common name. What makes it special is the detail that is provided. The region is divided into three areas, Bruce Peninsula (p), southern Bruce County (b), and Grey County (g). The area from which each taxon is known follows the latin name, e.g., p,b,g, or P,B,G, if the distribution of a native species is understood and is considered to be locally rare. In addition, marginal annotations have been made as follows:

- * Introduced from outside Ontario
- E Escaped from planting
- R Rare in Ontario — Natural Heritage Information Centre (S-ranking 1-3 only)
- H Historical Record — not recorded for 30 years or more, in some cases less if a single colony is known to be extirpated.

Pages 40 and 41 are Instructions for Reporting New or Rare Plants and Appendix A: Counties of Bruce and Grey Report of New or Rare Plant Species. Reports of new information should be sent to: Ministry of Natural Resources, 611 9th Avenue East, Owen Sound, Ontario N4K 3E4. They will in turn forward the information to the Bruce-Grey Plant Committee.

All of this makes this checklist one of the best yet produced and those who contributed to it are to be congratulated.

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## Sonoran Desert Plants: An Ecological Atlas

By Raymond M. Turner, Janice E. Bowers, and Tony L. Burgess. 1995. The University of Arizona Press, Tucson. xvi + 504 pp., illus. U.S. $70.00.

The Sonoran Desert Region occupies the southeast corner of California, the southwest quarter of Arizona, and, in Mexico, much of Baja California and about two-thirds of the State of Sonora. In 1972, J. R. Hastings, R. M. Turner, and D. K. Warren published *An Atlas of Some Plant Distribution in the Sonoran Desert.* This contained maps of 238 species. It was their intention, at that time, to compile "a more complete atlas showing the distribution of the major perennial plants of the Sonoran Desert".

The present volume includes 339 species representing 54 families. It is greatly enlarged from the earlier treatment and now includes such information as scientific name and authority, selected common names, description, diagnostic characters of similar species, taxonomic problems, habitat, distributional patterns in the maps and profiles, biogeography, phenology, physiology, reproductive ecology and pollination, seedling establishment, growth rate and life-span, horticulture, ethnobotany, and economic botany. In addition, beside each distribution map, there is a scale which depicts the altitudes of the localities on the map, a very unique feature. Scattered throughout the volume are a collection of photographs of various species, mainly taken by J. R. Hastings. These have a tendency to be rather dark, but still are most useful. A glossary, literature cited, and an index complete the work.

This publication represents a tremendous amount of work over a long period of time to ascertain the distributions, habitats, and other information on this group of most interesting plant species. It will be most useful both to those interested in their local vegetation and those who visit parts of the Sonoran Desert for the first time.

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## The Private Life of Plants

By David Attenborough. 1995. Princeton University Press. Princeton, New Jersey. 320 pp. + illus.

The book starts with "Plants can see. They can count and communicate with one another. They are able to react to the slightest touch and to estimate time with extraordinary precision." This statement succeeded in getting this reader's attention, curiosity, fascination, whatever you call it. The writing is lucid and concise. Technical terms are kept to a minimum. The numerous, excellent color photographs occupy about 50 per cent of the book

Attenborough says "This book is an attempt to see the natural world [of plants], not from our point of view, but from theirs." I had the feeling that the pupose of the book was to raise our level of awareness of the importance of plants in the World and how they are essential for our survival. It is not exaggeration to say that all animals, and that includes humans, depend upon plants for survival. What would our life be like without wheat, corn, beans, potatoes, grapes, etc. for food and drink? What would our diet be like without the grasses, clovers, grains, etc. that eventually appear in the markets as steaks, hams, and chops? Attenborough makes the point that we exploit plants, not only for food, but for clothes, building materials, and decoration. And the books shows how we do this and how, to put it in Attenborough's intriguing view, the plants use us.

The book is composed of six chapters that are titled: Travelling, Feeding and Growing, Flowering, The Social Struggle, Living Together, and Surviving. The format of each chapter is a series of detailed examples which illustrate the various aspects of the lives of plants. Attenborough travelled the World to assemble the fascinating examples that illustrate his story. Many of the items are from the exotic parts of the World where man has not trashed the landscape, thus destroying the natural areas where the plants and animals had developed, or evolved if you prefer, the specialized relationships on which a plant may depend for its survival. Some of the examples are marvels of intricacy, the reasons for which have escaped the eyes of man until recently.

Sex, in all sorts of permutations and moods, inevitably appears in every plant's private life. Sexual deception is a favourite theme, such as orchids that look like bees. And there are more than just plants. Whether you are interested in birds, bees or bats, this book has something for you.

Attenborough has produced a television series of the same name. The two overlap as well as complement each other.

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ENVIRONMENT

## Peterson First Guides: Forests

By John C. Kricher. 1994. Houghton Mifflin Co., Boston and New York. 128 pp., illus. U.S. $4.95.

This is truly a pocket guide being 9.5 x 18.5 cm. It is designed for adults (teenagers and up) and is an introduction to the various types of forests in North America with a distinct emphasis on the United States. The introduction discusses the identification of plants and animals, and the characteristics of forest types. The major part of the book treats 48 forest types. The format, with a couple of exceptions, devotes two pages to each forest type with a page of coloured illustrations of the plants and animals facing a page of descriptive text.

The illustrations are very good but there are some problems: 1) Most people will not be able to separate Red Crossbills from Pine Grosbeaks, page 70, because the distinctive differences are not clear. 2) The names Red-headed Woodpecker and Rose-breasted Grosbeak are reversed on page 54. 3) The Red-tailed Hawk illustration, page 14, shows a bird in a nest with only the head and tip of the back showing. It does not show the characteristic features needed to identify the bird. 4) Working with such a restricted number of pages and trying to deal with hundreds of organisms, it is perplexing to see some plants and animals illustrated more than once, for example, Sub-alpine Fir is shown on pages 74, 76, and 122.

The writing is sometimes wordy and sometimes repetitious. Thus some pertinent facts about the organisms could not be included. The content is sometimes confusing. For example, the phrase "Hickory seeds are contained in thick hickory nuts,..." is misleading, because the hickory seed is the nut. The nut is composed of a thick outer husk and a thinner inner shell which contains the kernel. The section on "Widespread North American mammals" includes the Pronghorn, the Collared Peccary, and the Grizzly Bear, three species which are restricted in numbers and geographical distribution,

but does not mention the Beaver, Porcupine, and Raccoon, three common and widespread mammals. The text describes the Great-horned Owl's call as "a resounding hoot," but a simple hoot is not the distinctive multinote call that is characteristic of this owl in the northeast. The distinctive features ofthe Pileated Woodpecker (page 113) should have included the red cap. And we are told that "Birds tend to be vocal and active during the daylight hours,..." But such a statement seems a poor use of crucial space which could have been used to tell readers that the hours of dawn and dusk are the best times to see and hear birds. Thus the quality is lower than that we associate with the Peterson Field Guides.

Despite some weaknesses, this is a good introductory guide to forest types and the plants and animals that inhabit those forests. I think most people will be impressed to see how many distinct types there are. It is recommended to all naturalists because of its broad overview of the plant communities which we commonly refer to as forests.

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## Terrestrial Ecosystems Through Time: Evolutionary Paleoecology of Terrestrial Plants and Animals

By A. K. Behrensmeyer, J. D. Damuth, W. A. DiMichele, R. Potts, H. D. Sues and S. L. Wing. 1992. University of Chicago Press. xix + 568 pp., illus.

In search of the universal we find impossibility. There can be no bible, a single book describing all there is to know of the past. Yet, we try, if for the only reason as to hint at the possibilities and complexities of our understanding of the past.

Most geologic or primary paleontological texts provide brief outlines of the major events in time and the changes geological or biological with perhaps a simple synthesis of what the ecosystems may have looked like. It is feared that the prospective student's next jump after learning the parochial is complete into whatever small field of taxon or time he or she choses, at least for a time, forgetting the interrelationships of groups at the higher level. *Terrestrial Ecosystems Through Time* not only bridges this gap, slowly leading the student along deeper into the caverns of knowledge but attempts to place the taxon or time in a global, continuous area, inflating the two dimensional faunal lists into three dimensional ecosystems.

The 541 pages of text and voluminous references introduce the ways of inferring ecology from morphology without neglecting the importance of sedimentological or taphonomic information. The complex and still growing data from today's ecosystems are even more mysterious yet wonderfully inciteful the further back in time (chapters 1-2).

If we examine specifically the fossil plants (introduced in chapter 3) and animals (introduced in chapter 4), each have their own pitfalls in paleoecological interpretation but many strengths as well. The floral record "preserves information about ancient vegetation on very fine temporal and spatial scales" (page 140). Morphology of species may indicate a particular role in the ecosystem (ecomorphs) to which information may be enhanced by locomotor capabilities, body size, and behaviour (e.g. dinosaur nests) to name a few.

The following three chapters are summaries of major biological events through time, Paleozoic, Mesozoic and early Cenozoic, and late Cenozoic. And the closer to the present we get, the complexity of species and their possible interactions increase, which is illustrated by the depth of discussions. Each chapter includes paleotopographic and plate position maps. The scope of these chapters is grand and the authors have relied on discussions with major participants in their respective fields. To synthesise the interelationships of species from bivalves, to plants, to man is herculean but the authors succeed in providing the essential hints of ecosystem reconstruction.

Though I used the term "student" as a potential user of this book I should underscore my meaning as a idealistic term. We are all students and no matter what level of our personal understanding we must be drawn back and reminded of the place in the grand scheme of things when an extant or extinct species belongs.

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## A Primer of Ecology

By Nicholas J. Gotelli. 1994. Sinauer Associates, Inc., Sunderland, Massachusetts. xiv + 206 pp., illus. U.S. $18.95.

Ecology is a tremendously varied and complex subject. If it weren't, life on earth would not be what it is. Most of us are interested in a relatively small area of ecology. Nevertheless we complain that too little is understood and there is too much to do within our field. A wide range of methods or techniques are available to help us understand the relationships between organisms which, after all, is what ecology is all about. The techniques range from a hand lens to DNA sequencing.

This book is an introduction to the mathematical models taught in university ecology courses. Models are necessary tools to the understanding of plant and animal communities, to describe past events, to predict the effects of natural events, and to the application of management techniques on existing populations. It is the author's contention that ecology textbooks do not give enough explanation to the simpler mathematical models, in particular the exponential model of population growth. As a result the students lack the detailed understanding necessary to use and manipulate the more complex models. The goal of the author was "to present a concise but detailed exposition of the most common mathematical models in population and community ecology." An understanding of continuous differential equations and calculus is assumed.

The seven chapters are titled: exponential population growth, age-structured population growth, metapopulation dynamics, competition, predation, and island biogeography. Each chapter is divided into sections on model presentation and predictions, model assumptions, model variations, empirical examples, problems, and solutions.

The empirical examples section of each chapter focusses on a few field studies and how mathematical models either explain trends or could have been applied to predict trends. In one example the Song Sparrow population of Mandatre Island, British Columbia, is used to illustrate the concepts of density-dependent and density-independent. Island populations are a favored situation for population studies because the isolation reduces the factors affecting fluctuations; i.e., emigration and immigration are often nil. The Song Sparrow population has varied greatly but its variation did not conform to a simple logistic growth model. Analyses indicated that space and food limitations determined breeding success, because only a limited number of breeding males could establish territories. The excess male population or "floater males" would move in if a resident male was lost. Food, when artificially supplied, resulted in a fourfold increase in chicks. Some other examples are Grizzly Bear populations, Red Grouse and its parasites, hare-lynx cycles, and competition between intertidal sandflat worms.

A well-written book treating a specialized aspect of ecology, this is certainly not everyone's piece of cake because the mathematics is too detailed. However, the basic premises are parts of ecology that we should, at least, be aware of.

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## The Wilderness Condition: Essays on Environment and Civilization

Edited by Max Oelschlaeger. 1992. Sierra Club Books, San Francisco, California. 345 pp.

One of the most positive results of society's heightened environmental awareness is our increased knowledge and appreciation of wilderness. For many of us, wilderness can be a tonic for everything that creates stress in us and that separates us from the earth. The media have also discovered the environment, providing extensive coverage of certain high-profile issues. While it is vital to be aware of current environmental topics, it is most refreshing to occasionally read a well-written book that avoids discussing any of these more transitory and newsworthy environmental topics in favour of more fundamental issues.

*The Wilderness Condition* is such a book, an impressive anthology of essays that reflect on the subject of wilderness philosophy. That subject may not seem to be the most natural combination, but, in this book, the tripartite marriage of wilderness, philosophy, and history seems to work quite well. The essays comprising this volume were orginally presented at a 1989 conference in Colorado, then published in both hard cover and softcover versions.

*The Wilderness Condition* concerns some of the more underlying and often-neglected environmental issues of our society. The simple subject of the essays in this book is the tortured relationship between civilization and the environment. So, instead of just covering the more current environmental issues, this book provides readers with some necessary background reading on this subject.

Max Oelschlaeger, the editor of this volume and the author of both the introduction and the last chapter, states that this book finds its role primarily in the "re-greening of the American consciousness." What

an ambitious goal!! Towards this end, the writers address some of the more subtle values of wilderness and the relationship between wild nature and civilization in a manner designed to facilitate cross-disciplinary discussion. Three themes unite this collection of essays: the evolutionary perspective that confirms why humankind and nature are necessarily interdependant, how our language reflects our understanding (or lack thereof) of environmental issues, and finally how we can initiate a new recognition of the environment as a "vital entity". For those interested in these aspects of wilderness, this volume certainly contains a wealth of valuable information.

The authors explore the dynamic tension between wild nature and civilization, offering insights into why this relationship has become so tortured. They argue that no amount of technology will ever displace our primal connection to nature. Rather than simply deploring the prevailing attitudes towards our imperiled environment, the authors also offer fresh, realistic and inspiring ideas for alleviating the crisis.

Oelschlaeger emphasizes the diversity of the writers' backgrounds. Most of the essayists are also university instructors and their choice of topics and writing style relects their varied levels of academic expertise, often with a resultant prose that is a little too pedantic. Nevertheless, all the authors have impressive writing credentials in wilderness philosophy and environmental ethics, including Gary Snyder and Paul Shepard. As with many anthologies, there is some unevenness in the style of writing, but this can also be viewed as a opportunity to enjoy this variety of rhetoric.

Many of the chapters concern notable topics. Shepard presents his theory of a primitive development of wilderness. Michael Zimmerman looks at the relationship between wilderness and the human condition, as seen through the eyes of other writers. There are also predictable discussions of the eco-philosophies of Aldo Leopold and John Muir (by Curt Meine and Peter Michael Cohen, respectively), perhaps not too surprising seeing as how the hard-cover version of this book was published by the Sierra Club. Finally, Oelschlaeger himself explores the use of language by some of the great wilderness writers.

Perhaps a result of the topics and authors, many of this book's chapters are heavy and extensive reading. Many of the essays carry catchy titles, but one brief Appendix is laborously titled "Exegesis of Claude Levi-Strauss's Idea of Nature as Totemic Metaphor and Caste Metonym" ..., not exactly something you can sit down and casually read. At the end of the volume, there are two appendices and a detailed series of references and notes for each of the chapters. In addition, I was particularly impressed with the effusive prose on the dust cover of the hard cover version of the book.

Our society has become so enamoured with wilderness that many people will travel for hours to find the last vestiges of anything remotely wild or will read virtually anything on the subject. Unfortunately, many of us wilderness lovers lack a strong background in wilderness philosophy. It is books like *The Wilderness Condition* that can provide some valuable reading to help us develop that much-needed philosophy and environmental ethic. Our love for wilderness suggests that this is a worthwhile first step.

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MISCELLANEOUS

## Evolutionary Archaeology: Methodological Issues

Edited by Patrice A. Teltser. 1995. The University of Arizona Press, Tucson, Arizona. 216 pp., illus. Cloth U.S.$45; Paper U.S. $21.95.

The contributors to *Evolutionary Archaeology* examine the applicability of Darwinian evolutionary theory to the evolution of archaeological material culture. Their main premise is that artifacts are part of the human phenotype; therefore, Darwinian evolutionary processes act upon material culture in the same way as they act upon the human phenotype.

The chapters consist either of theoretical and methodological discussions or of examples in which these principles are used to explain archaeological phenomena. The introductory chapters (Teltser; Jones, Leonard, and Abbott; and Dunnell) provide a stimulating discussion of the differences between traditional cultural evolutionary theory (which they refer to as "essentialist") and an evolutionary theory more closely aligned with Darwinian origins and principles, which they call "selectionist". The major difference, as they see it, is that selectionist evolution makes no assumptions about the "progressive" nature of evolutionary changes, whereas traditional cultural evolutionary theory has assumed that change is directional and progressive.

My reaction to this book is definitely mixed On the positive side, they argue for more rigour in selecting units with which to measure evolution. For example, Dunnell (Chapter 3) appropriately criticizes the use of artifact "type", a discontinuous phe-

nomenon, as the unit by which to measure evolution, which is a continuous phenomenon.

On the other hand, I find the authors' strict focus on the artifact to be both reductionist and mechanistic. It ignores the role of knowledge as the means by which technology is used to enhance the potential reproductive success of the human phenotype (see Ridington 1988). In fact, survival involves a complex interaction of knowledge, technology, and actors (Hakken 1993). Granted, archaeologists find artifacts and not "knowledge"; nevertheless, to ignore this complex interaction weakens the theory.

In fact, the more I read of the book, the more I began to question the explanatory power of selectionist theory to explain this complex interaction. For example, both Jones, Leonard, and Abbott (Chapter 2) and Ramenofsky (Chapter 7) discuss the non-role of intent in shaping human adaptation. Their proposition is that intent is solely a source of variation and not a mechanism by which traits are selected (true enough). But the selectionist explanation seems to be too simplistic to descibe the complex course of events that follow an initial act of intent, especially when we see in our contemporary society the continuation and proliferation of technology that appears to provide anything BUT reproductive success (see for example, Lutz 1996). Given the complex nature of the interaction among technology, knowledge, and society, chaos and complexity theory (cf., Saperstein 1995) seem to be more appropriate than selectionist theory for explaining cultural evolution.

While I found the theoretical chapters stimulating (even though I didn't agree with everything), I found the chapters describing examples of applied selectionist theory quite unconvincing. They did not provide me with any new insight into artifact change and the adaptive advantages it provided. Furthermore, they made several questionable assumptions. Graves and Ladefoged (Chapter 8), for example, propose that activity which is NOT directed toward food-gathering or reproduction is more likely to originate in places where environmental perturbations are more likely to be severe, namely at the "geographic margins of a regionally distributed archaeological complex" (page 162). They provide neither rational nor example to explain and demonstrate why this would be so; and I could not think of any examples out of my own experience that would support such a proposition.

In O'Brien and Holland's conclusion, they state that their intent was to convince archaeologists of selectionist evolution's "powerfulness relative to explaining variation in the archaeological record" (page 176). They haven't convinced me.

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## Huxley: The Devil's Disciple

By Adrian Desmond. 1994. Michael Joseph, London. 475 pp., photographs.

Adrian Desmond's first foray into biographical accounting, in book form, was hand in hand with J. Moores and the object of their desire was the 19th century centre piece of biological awareness, Charles Darwin. Despite the richness of the Darwinia industry the success of *Darwin* is two fold; the incorporation of the multitude of original source (Darwin was one of the most avid 19th century note takers); and the continual connection of the purple prose of the Victorian era with contemporary feeling. The book reads like a novel, the center character, fully inflated from the pages is a person, affected by the social, political, scientific, and personal. *Huxley: The Devil's Disciple* is Desmond's newest contribution, done in the same vein; 379 pages of flowing text, with nearly a hundred pages of references.

The term "bull dog" is often associated with T. H. Huxley (1825-1895). By definition a bull dog, is subservient to his master (in popular perception to Darwin) and who would do the nasty business when called upon. Desmond's new accounting shows in vivid detail that Huxley was not the usual bull dog ("if I had a wish to live thirty years, it is that I may see the foot of Science on the necks of her Enemies", page 253) but for the most part he was his own master, serving his own needs. In his early days his frustration with patronage appointments and the low value of science in universities forged his fight to correct these trends and in turn making his voice a (paid) sound of reason (and to think that he might have come to Canada to hold a post at the University of Toronto in 1851). He disliked the political and rich appointments to the few chairs in science by the old guard but felt that a position should be earned on merit and determi-

nation. A philosophy that extends past the halls of academia. His fights, and there were many, spanned the spectrum of 19th century ideas from external politics of science to evolution, human origins and human rights, religion, and education for the masses. All these were no where so cleverly, and clearly put than out of the mouth or with pen than of T. H. Huxley.

We read or hear tales of the giants whose shoulders we stand on and at times, due to our own ignorance, don't even know whose shoulders they are. Huxley fought hard for the rights of the down trodden, though many of these rights and ideas were not conceived by him no one enjoyed being in the wrong with him. His rival, Richard Owen, the "Cuvier of England" found that out the hard way when the issue of human origins and our species relationships were seriously, for the first time, examined. Owen, who wasn't allergic to the idea of evolution, had a severe reaction to it when our species was dragged into the discussion. Huxley's role as a scientist was two fold: not only illustrate to your learned colleagues what you are doing as a scientist but also open up to the public, no matter at what station in life they may be, and let them rejoice in your discovery, no matter how seemingly mundane. Make them believe that ideas are not strictly for the rich or powerful. That coachmen and housemaids have the right to learn too. No one did it better.

Unlike financially secure gentlemen of science like Darwin, Huxley was a man of his times, continually in debt, family obligations demanding time, finding a way to survive the personal pain of the loss of a child, and yet keep the strength and focus to swing the sword of the righteous. In some ways it was a different time than today. But in many ways things haven't changed all that much. All the issues and feelings of Huxley and his time are still prevalent today.

Desmond does not document the latter years of Huxley's life (1871-1895) when a person's seniority must bare witness for the new breed of bull dogs, sinners and saints. A transition that no one likes. By 1870 when the book ends, Huxley had succeeded, to the benefit of his country and science as a whole, in either initiating, guiding, or witnessing great change in a century that we are beginning to see only through the fog of time. Like *Darwin*, Desmond's *Huxley* dissipates the fog of the mythical, and portrays the real. At least as real as a hundred years of retrospection can serve up.

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## NEW TITLES

### Zoology

*__Amphibians of Oregon, Washington, and British Columbia: a field identification guide.__ 1996. By C. C. Corkran and C. Thomas. Lone Pine Publishing, Edmonton. 173 pp., illus. $21.95; U.S. $16.05

*__Animal evolution: interrelationships of the living phyla.__ 1995. By C. Nielsen. Oxford University Press, Don Mills, ix + 467 pp., illus. $67.50.

*__Atlantic coastal birds.__ 1996. Edited by K. Kaufman. Peterson Flash Guides. Houghton Mifflin, New York. 24 panels. U.S. $7.95; $10.95.

*__Atlas of Saskatchewan Birds.__ 1966. By A. R. Smith. Special Publication No. 22. Saskatchewan Natural History Society, Regina. 456 pp., illus. $45.

*__Atlas of the distribution of fish within the Canadian tributaries of western Lake Superior.__ 1996. By W. T. Momot and S. A. Stephenson. Centre for Northern Studies, Lakehead University, Thunder Bay. 383 pp., illus. $30.

*__A birder's guide to Trinidad and Tobago.__ 1996. By W. L. Murphy. 2nd edition. Peregrine Enterprises, Parkersburg, West Virginia. U.S. $15.95.

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*__Birds of the Besnard Lake area.__ 1996. By G. G. Bortolotti and K. Wiebe. Special Publication No. 20. Saskatchewan Natural History Society, Regina. 456 pp., illus. $12.

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Mammals of Australia. 1996. Edited by R. Strahan. Smithsonian Institute Press. Washington. 756 pp., illus. U.S. $75.

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†Prairie night: black-footed ferrets and the recovery of endangered species. 1996. By B. Miller. R. P. Reading. and S. Forrest. Smithsonian University Press. Washington. xvii + 254 pp., illus. U.S. $34.95.

Readings in animal cognition. 1996. By M. Beckoff and D. Jamison. MIT Press, Cambridge, Massachusetts. xv + 379 pp., illus. U.S. $30.

*Red fox: the catlike canine. 1996. By J. D. Henry. New edition. Smithsonian Institute Press, Washington. 174 pp., illus. U.S. $15.95.

*Red-winged blackbirds: decision-making and reproductive success. 1996. By L. D. Beletsky and G. H. Orians. University of Chicago Press. Chicago. c288 pp., illus. Cloth U.S. $54: paper U.S. $21.95.

Sea stars, sea urchins, and allies: echinoderms of Florida and the Caribbean. 1996. By G. Hendler. Smithsonian Institute Press. Washington. xi + 390 pp., illus. U.S. $39.95.

The Snow geese of La Perouse Bay: natural selection in the wild. 1995. Oxford University Press, Don Mills. xv + 297 pp., illus. $106.95.

The species composition of peracarid fauna (Crustacea, Malacost race) of the northwest water polynya (Greenland). 1996. By A. Brandt, S. Vassilenko. D. Pipenburg, and M. Thurston. Meddelelser om Gronland. Bioscience 44. 30 pp., DKK 80.

†Studies of high-latitude seabirds, 4: trophic relationships and energetics of endotherms in cold ocean systems. 1996. Edited by W. A. Montevecchi. Papers from the Marine Birds and Mammals in Arctic Food Webs Symposium, St. John's, Newfoundland, 1992. Occasional Paper No. 91. Canadian Wildlife Service, Ottawa. 73 pp., illus. Free.

Views from the bridge: a memoir of freshwater fishes of Trinidad. 1995. By Julian S. Kenny. Rapid Environmental Assessments. 74 Ana Street. Port of Spain, Trinidad. U.S. $20.

Watchable birds of the southwest. 1995. By M. T. Gray. Mountain Press, Missoula. ix + 187 pp., illus. U.S. $14.

†Whitetail spring. 1996. By J. Ozoga. Seasons of the Whitetail Book 3. Willow Creek Press, Minocqua, Wisconsin. 144 pp., illus. U.S. $29.50.

Wild bears of the world. 1996. By P. Ward and S. Kynaston. Facts on File, New York. 192 pp., illus. U.S. $25.95.

The wisdom of the hive: the social ecology of honey bee colonies. 1996. By T. D. Seeley. Harvard University Press, Cambridge. Massachusetts. xiv + 295 pp., illus. U.S. $49.95.

## Botany

Agnes Chase's first book of grasses: the structure of grasses explained for beginners. 1996. By L. G. Clark and R. W. Phol. 4th edition. Smithsonian Institute Press, Washington. 176 pp., illus. U.S. $16.95.

Caliciales. 1996. By L. Tibell. The New York Botanical Garden. Bronx. 79 pp., illus. U.S. $20.

Conifers: the illustrated encyclopedia. 1996. By D. M. van Gelderen and J. R. F. van Hoey Smith. Timber Press, Portland, Oregon. 2 volumes, 706 pp., illus. U.S. $125.

†Ecology and management of Sitka Spruce: emphasizing its natural range in British Columbia. 1996. By E. B. Peterson, N. M. Peterson, G. F. Weetman, P. J. Martin. and W. Stanek. c240 pp., illus. $65.

Ecology of the southern conifers. 1996. Edited by N. J. Enright and R. S. Hill. Smithsonian Institute Press, Washington. 352 pp., illus. U.S. $60.

Glàdiolus in Africa: systemics, biology, and evolution. 1996. By P. Goldblatt. Timber Press, Portland, Oregon. 256 pp., illus. U.S. $39.95.

How to draw plants: the techniques of botanical illustration. 1996. By K. West. Timber Press, Portland, Oregon. 152 pp., illus. U.S. $19.95.

†Leaf venation patterns, volume 7: the classification of leaf venation patterns. 1995. By E. P. Klucking. J. Cramer, Stuttgart. 337 pp., illus. DM 270.

Nevada vascular plant types and their collectors. 1996. By A. Tiehon. New York Botanical Garden, Bronx. 103 pp.

Juncaceae. 1996. By H. Balslev. Flora Neotropica Volume 68. New York Botanical Garden, Bronx. 163 pp., illus. U.S. $29.50.

**Orchids of Kenya.** 1996. By J. Stewart. Timber Press, Portland, Oregon. 144 pp., illus. U.S. $55.

**Palms throughout the world.** 1996. By D. L. Jones. Smithsonian Institute Press, Washington. 410 pp., illus. U.S. $49.

*__Plant collecting for the amateur.__ 1996. By T. C. Brayshaw. U.B.C. Press, Vancouver. 44 pp., illus.

*__Plants of southern interior British Columbia.__ 1996. Edited by R. Parish, R. Coupé, and D. Lloyd. Lone Pine, Edmonton, 463 pp., illus. $24.95; U.S. $19.95.

*__Plants of the western boreal forest and aspen parkland.__ 1995. By D. Johnson, L. Kershaw, A. Mackinnon, and J. Pojar. Lone Pine, Edmonton. 392 pp., illus. $24.95.

**Silk tree, guanacaste, monkey's earring: a generic system for the synadrous Mimosaceae of the Americas, part 1: *Abarema, Albizia*, and allies.** 1996. By R. C. Barnaby and J. W. Grimes. New York Botanical Garden, Bronx. 292 pp., illus. U.S. $45.

**Trees of the northern United States and Canada.** 1995. By Iowa State University Press, Ames. x + 502 pp., illus. U.S. $39.95.

**Trees of Nova Scotia: a guide to native and exotic species.** 1996. By G. Saunders. Nimbus, Halifax. 112 pp., illus. $9.95.

†**Wildflowers: legends, poems, paintings.** 1996. Reprint of 1989 edition. By N. R. Ranson and M. J. Laughlin. Texas A & M University, College Station xii + 82 pp., illus.

### Environment

†**The abstract wild.** 1996. By J. Turner. University Arizona Press, Tuscon. c180 pp. Cloth U.S. $32.50; paper U.S. $15.95.

**Agricide: the hidden farm and food crisis that affects us all.** 1996. By M. W. Fox. 2nd edition. Krieger, Melbourne, Florida. U.S. $33.50.

†**An ancient forest of the Lake Temagami site region (4E).** 1996. By P. Quinby and T. Lee. Canadian Nature Federation, Ottawa. 72 pp., illus. + map. $10.

†**Balancing act: environmental issues in forestry.** 1996. By H. Kimmins. 2nd edition. UBC Press, Vancouver. c272 pp., illus. $29.95.

†**The biology of rocky shores.** 1996. By C. Little and J. A. Kitching. Oxford University Press, London. 272 pp., illus. Cloth £35; paper £14.95. Oxford University Press, Don Mills. Cloth $94.50; paper $40.50.

†**The Boundary Waters wilderness ecosystem.** 1996. By M. Heinselman. University Minnesota Press, Minneapolis. 384 pp., illus. U.S. $24.95.

**Bring back the buffalo: a sustainable future for America's great Plains.** 1996. By E. Callenbach. Island Press, Washington. 280 pp., illus. U.S. $22.50.

**Dinosaurs, diamonds, and things from outer space: the great extinction.** 1995. By D. B. Carlisle. Stanford University Press, Stanford. viii + 241 pp., illus. Cloth U.S. $45; paper U.S. $17.95.

**Discover America: the Smithsonian book of the national parks.** 1996. By C. E. Little. Smithsonian Institute Press, Washington. 224 pp., illus. U.S. $34.95.

†**Ecological identity: becoming a reflective environmentalist.** 1995. By M. Thomashow. MIT Press, Cambridge, Massachusetts. xxii + 228 pp., illus. U.S. $12.50.

†**Ecology of a polar oasis: Alexandra Fiord, Ellesmere Island, Canada.** 1996. Edited by J. Svoboda and B. Freedman. Captus Press, North York, Ontario. 286 pp. $38.50.

†**Evolution and environment in tropical America.** 1996. Edited by J. B. C. Jackson, A. F. Budd, and A. G. Coates. c400 pp., illus. Cloth U.S. $65; paper U.S. $27.50.

**Far from tame: reflections from the heart of a continent.** 1996. By L. Allman. University of Minnesota Press, Minneapolis. 176 pp., illus. U.S. $16.95.

*__Field guide to ecosites of the mid-boreal ecoregions of Saskatchewan.__ 1996. By J. D. Beckingham, D. G. Nielsen, and V. A. Futoransky. U.B.C. Press, Vancouver. xv + 446 pp., illus.

*__Field guide to ecosites of northern Alberta.__ 1996. By J. D. Beckingham and J. H. Archibald. U.B.C. Press, Vancouver. xiv + 515 pp., illus. + map.

†**Field guide to ecosites of Southwestern Alberta.** 1996. By J. H. Archibald, G. D. Klappstein, and I. G. W. Corn. U.B.C. Press, Vancouver. xiii + 505 pp., illus. + map. $29.95.

†**Field guide to ecosites of west-central Alberta.** 1996. By J. D. Beckingham, I. G. W. Corns, and J. H. Archibald. Canadian Forestry Service Special Report 9. U.B.C. Press, Vancouver. xiv + 622 pp., + map.

**Floods of fortune: ecology and economy along the Amazon.** 1996. By M. Goulding, N. J. H. Smith, and D. J. Mahar. Columbia University Press, New York. vii + 193 pp. illus. U.S. $29.95.

†**The food web of a tropical rain forest.** 1996. Edited by D. P. Reagan and R. B. Waide. University Chicago Press, Chicago. xi + 616 pp., illus. Cloth U.S. $110; paper U.S. $39.95.

**Imperiled waters, impoverished future: the decline of freshwater ecosystems.** 1996. By J. N. Abramovitz. Worldwatch Institute, Washington. 80 pp., illus. $5.

*__In search of nature.__ 1996. By E. O. Wilson. Island Press, Washington. x + 214 pp., illus. U.S. $19.95.

**The magic ground.** 1996. By H. Horwood. Nimbus, Halifax. 196 pp., illus. $16.95.

**Marine biology: function, biodiversity, ecology.** 1995. By J. S. Levinton. Oxford University Press, London. 448 pp., illus. £21.50. Oxford University Press, Don Mills. $71.

†**The marshes of southwestern Lake Erie.** 1995. By L. W. Campbell. Ohio University Press, Athens. xii + 233 pp., illus.

*__The natural history of pollination.__ 1996. By M. Proctor, P. Yeo, and A. Lack. Timber Press, Portland Oregon. 487 pp., illus. Cloth U.S. $42.95, paper U.S. $24.95.

**Nature in danger: threatened habitats and species.** 1996. By N. Simon. Oxford University Press, New York. 240 pp., illus. U.S. $35.

**Nature's imagination: the frontiers of scientific vision.** 1995. Edited by J. Cornwell. Oxford University Press, New York. xii + 212 pp., illus. U.S. $23.

**Null models in ecology.** 1996. By N. J. Gotelli and G. R. Graves. Smithsonian Institute Press, Washington. 400 pp., illus. Cloth U.S. $65; paper U.S. $30.

†**Ontario's old growth: a learner's handbook.** 1996. By M. Stabb. Canadian Nature Federation, Ottawa. 47 pp., illus. $7.

**On the rocks: earth science for everyone.** 1996. By J. S. Dickey, Jr. Wiley, New York. xix + 275 pp., illus. $16.95.

†**Prairie conservation.** 1996. Edited by F. B. Samson and F. L. Knopf. Island Press, Washington. 339 pp., illus. Cloth U.S. $50; paper U.S. $28.

**A primer of ecology.** 1995. By N. J. Gotelli. Sinauer, Sunderland, Massachusetts. xvii + 206 pp., illus. U.S. $18.95.

†**Protecting Canada's endangered Spaces: an owner's manual.** 1995. Edited by M. Hummel. Key Porter Books, Toronto. xix + 251 pp., illus. $27.23.

†**Riparian ecosystem recovery in arid lands: strategies and references.** 1996. By M. K. Briggs. University of Arizona Press. Tuscon. c200 pp., illus. Cloth U.S. $45; paper U.S. $19.95.

†**Sea life: a guide to the marine environment.** 1996. Edited by G. Waller. Smithsonian Institute Press, Washington. 432 pp., illus. U.S. $49.95.

**Seasons of the wild: a year of nature's magic and mysteries.** 1995. By S. Montgomery. Chapters, Shelburn, Vermont. 152 pp., illus. U.S. $12.95.

**The stork and the plow: the equity answer to the human dilemma.** 1995. By P. R. Ehrlich, A. H. Ehrlich, and G. C. Daily. Putnam's New York. xvi + 364 pp., illus. U.S. $30.

### Miscellaneous

†**Annotated diaries, including observations on birds, written by Thomas N. Hayman in 1938 and 1940 at London and St. Catharines, Ontario, Canada.** 1996. By W. W. Judd. Phelps Publishing. Order from W. W. Judd, 50 Hunt Club Drive, London, Ontario N6H 3Y3. 79 pp., illus. $10.

### Books for Young Naturalists

**Bark; Grasses.** 1996. By C. Chambers. Raintree, Austin. Each 32 pp., illus. U.S. $14.98.

**The butterfly alphabet book.** 1995. By B. Cassie and J. Pallotta. Charlesbridge, Waterdown, Massachusetts. 30 pp., illus. U.S. $14.95.

**A city under the sea: life in a coral reef.** 1996. By N. Wu. Atheneum, N.Y. 28 pp., illus. U.S. $16.

**The complete handbook of science fair projects.** 1996. By J. B. Bochinski. Revised edition. Wiley, New York. xviii + 221 pp., illus. U.S. $14.95.

**Dinosaurs.** 1966. By J. Howard. Troll, Mahwah, New Jersey, 48 pp., illus. U.S. $4.95.

**The ocean deep.** 1966. By F. Dipper. Copper Beech Books, Brookfield, Connecticut. 40 pp., illus. Cloth U.S. $15.90; paper U.S. $6.95.

**One small square: cactus desert.** 1995. By D. M. Silver. Scientific American Books for Young Readers, New York. 48 pp., illus. U.S. $14.95.

**Ornithominids: the fastest dinosaur.** 1996. by D. Lessem. Carolrhoda, Minneapolis. 40 pp., illus. U.S. $14.96.

**Rainforest; Temperate forest; Tundra.** 1996. By E. Kaplan. Benchmark Books, New York. each 64 pp., illus. U.S. $15.95.

**Seabirds.** 1995. By P. Sterry. Raintree, Austin, Texas. 32 pp., illus. U.S. $13.98.

**Shells.** 1996. By C. Chambers. Raintree, Austin. 32 pp., illus. U.S. $14.98.

**There's a wolf in the classroom!** 1995. By B. Weide and P. Tucker. Carolrhoda, Minneapolis. 56 pp., illus. U.S. $16.13.

**Trondon: the smartest dinosaur.** 1996. By D. Lessem. Carolrhoda, Minneapolis. 40 pp., illus. U.S. $14.96.

**Whats it like to be a fish?** 1996. By W. Pfeffer. Harper Collins, New York. 32 pp., illus. U.S. $14.95.

*assigned for review
†available for review

# Index to Volume 110

## Compiled by Leslie Durocher

## Index to Book Reviews

**Miscellaneous**



**Zoology**

## *The Canadian Field-Naturalist:* A continuation of 117 years of publication on northern North American biodiversity — 1880–1996

*The Canadian Field-Naturalist* is the official publication of The Ottawa Field-Naturalists' Club and features both articles and notes on original research and observations on the natural history primarily of northern North America (including distribution, faunal analyses, taxonomy, ecology, and behaviour) [Northern Eurasian contributions would also be welcome]. Issues include news and comment (Club annual meetings and awards, tributes and review papers) and book review and new title sections. Since 1984 it has frequently included edited Status Reports for selected species from those designated by the Convention on Species of Endangered Wildlife in Canada (COSEWIC). Recent special issues have been on a history of vascular plant exploration in North America, and the life of P.A. Taverner. It is entirely supported through club membership and subscriptions, page and reprint charges. In 1996 The Ottawa Field-Naturalists' Club had 1024 members and *The Canadian Field-Naturalist* an additional 254 individual and 511 institutional subscribers, for a distribution of 1789 copies.

The Ottawa Field-Naturalists' Club was formed in 1879 by scientists from embryonic federal departments including the Geological Survey and the Dominion Experimental Farm and leading amateurs; this type of mix remains its strength to this day. The Club quickly emphasized publication, and for seven years beginning in 1880, it annually issued the *Transactions of the Ottawa Field-Naturalists' Club.* With volume 3 in 1887, the *Transactions* became a subtitle of Volume 1 of *The Ottawa Naturalist*, a monthly publication. With Volume 3 of *The Ottawa Naturalist* in 1889 the emphasis changed from local members reports to national ones, and in 1919 the journal was renamed *The Canadian Field-Naturalist* (starting with Volume 33 which was Volume 35 of the *Transactions* but this subtitle was subsequently dropped). The issues per year were gradually reduced from 12 to 9 to 6 and eventually to 4, the latter beginning with Volume 67 in 1953. The number of pages to a volume is variable, highest in 1988 (volume 102) at 798. The largest single issue was 110(1) at 254 pages. Since 1967, the Club has separately published a local (Ottawa area) natural history journal, *Trail & Landscape*, now also issued 4 times a year.

Submissions to *The Canadian Field-Naturalist* and predecessors have long been peer reviewed, first through a "Publishing Committee", later "Sub-editors", then "Assistant Editors" until the designation "Associate Editors" was adopted in 1885 and maintained ever since. Currently, most submissions also go to at least one (and often more) additional reviewer(s). Associate Editors are listed in every issue and since 1982 additional reviewers been acknowledged annually in the Editor's Report. A formal publication policy was published in *The Canadian Field-Naturalist* 97(2): 231–234. "Advice to Contributors" is published in one or more issues annually. The current subscription rates are $23 for individuals and $38 for institutions. Postage outside Canada is $5.00 additional. Subscriptions should be sent to The Canadian Field-Naturalist, Box 35069 Westgate P.0., Ottawa, Ontario, Canada K1Z 1A2. Manuscripts for consideration should be addressed to Dr. Francis R. Cook, Editor, Canadian Field-Naturalist, RR 3, North Augusta, Ontario, Canada K0G 1R0.

FRANCIS R. COOK

In the Next Issue

THE CANADIAN FIELD-NATURALIST

**Volume 111 Number 1 1997**

**A Special Issue**

**Orchids of the Ottawa District, Ontario: Floristics, Phytogeography, Populations Studies and Historical Review**

JOYCE REDDOCH AND ALLAN REDDOCH

*Containing:*

History of orchid collecting and recording

Climate, geology, and vegetation

Principal orchid habitats

Local distribution patterns

Continental distribution patterns

Rare species

Need for protection and management

Colour forms and their nomenclature

Blooming periods

Capsules and seeds

Overwintering states

Longevity of colonies

Variability of characters

Individual accounts for each of 44 species

Excluded species and possible additional species

Summary of lists of orchids of the Ottawa District and adjacent areas

Significant vegetation of six calcareous sedge fens

# Advice to Contributors

## Content

*The Canadian Field-Naturalist* is a medium for the publication of scientific papers by amateur and professional naturalists or field-biologists reporting observations and results of investigations in any field of natural history provided that they are original, significant, and relevant to Canada. All readers and other potential contributors are invited to submit for consideration their manuscripts meeting these criteria. The journal also publishes natural history news and comment items if judged by the Editor to be of interest to readers and subscribers, and book reviews. Please correspond with the Book Review Editor concerning suitability of manuscripts for this section. For further information consult: A Publication Policy for the Ottawa Field-Naturalists' Club, 1983. *The Canadian Field-Naturalist* 97(2): 231-234. Potential contributors who are neither members of *The Ottawa Field-Naturalists' Club* nor subscribers to *The Canadian Field-Naturalist* are encouraged to support the journal by becoming either members or subscribers.

## Manuscripts

Please submit, **to the Editor**, in either English or French, **three** complete manuscripts **written in the journal style**. The research reported should be original. It is recommended that authors ask qualified persons to appraise the paper before it is submitted. Also authors are expected to have complied with all pertinent legislation regarding the study, disturbance, or collection of animals, plants or minerals. The place where voucher specimens have been deposited, and their catalogue numbers, should be given. Latitude and longitude should be included for all individual localities where collections or observations have been made.

Type the manuscript on standard-size paper, if possible use paper with numbered lines, **double-space throughout**, leave generous margins to allow for copy marking, and **number each page**. For Articles and Notes provide a bibliographic strip, an abstract and a list of key words. Generally words should not be abbreviated but use SI symbols for units of measure. Underline only words meant to appear in italics. The names of authors of scientific names should be omitted except in taxonomic manuscripts or other papers involving nomenclatural problems. "Standard" common names (with initial letters capitalized) should be used at least once for all species of higher animals and plants; all should also be identified by scientific name.

The names of journals in the Literature Cited should be written out in full. Unpublished reports should not be cited here but placed in the text or in a separate documents section. Next list the captions for figures (numbered in arabic numerals and typed together on a separate page) and present the tables (each titled, numbered consecutively in arabic numerals, and placed on a separate page). Mark in the margin of the text the places for the figures and tables.

Extensive tabular or other supplementary material not essential to the text, typed neatly and headed by the title of the paper and the author's name and address, should be submitted in duplicate on letter-size paper for the Editor to place in the Depository of Unpublished Data, CISTI, National Research Council of Canada, Ottawa, Canada K1A 0S2. A notation in the published text should state that the material is available, at a nominal charge, from the Depository.

The **Council of Biology Editors Style Manual**, Fourth edition (1978) available from the American Institute of Biological Sciences, and **The Canadian Style: A Guide to Writing and Editing**, Department of the Secretary of State and Dundurn Press Ltd (1985) are recommended as general guides to contributors but check recent issues (particularly in literature cited) for exceptions in journal format. Either "British" or "American" spellings are acceptable in English but should be consistent within one manuscript. **The Oxford English Dictionary, Webster's New International Dictionary** and le **Grand Larousse Encyclopédique** are the authorities for spelling.

## Illustrations

Photographs should have a glossy finish and show sharp contrasts. Photographic reproduction of line drawings, **no larger than a standard page**, are preferable to large originals. Prepare line drawings with India ink on good quality paper and letter (don't type) descriptive matter. Write author's name, title of paper, and figure number on the lower left corner or on the back of each illustration.

## Reviewing Policy

Manuscripts submitted to *The Canadian Field-Naturalist* are normally sent for evaluation to an Associate Editor (who reviews it or asks another qualified person to do so), and at least one other reviewer, who is a specialist in the field, chosen by the Editor. Authors are encouraged to suggest names of suitable referees. Reviewers are asked to give a general appraisal of the manuscript followed by specific comments and constructive recommendations. Almost all manuscripts accepted for publication have undergone revision — sometimes extensive revision and reappraisal. **The Editor makes the final decision** on whether a manuscript is acceptable for publication, and in so doing aims to maintain the scientific quality, content, overall high standards and consistency of style, of the journal.

## Special Charges — Please take special note

Authors **must share in the cost of publication** by paying $74 for each page in excess of five journal pages, plus $10 for each illustration (any size up to a full page), and up to $74 per page for tables (depending on size). Reproduction of color photos is extremely expensive; price quotations may be obtained from the Business Manager. Reprint order forms are included when galley proofs are sent to authors. If grant or institutional funds are available, we ask authors to defray a higher proportion of the cost of publishing, $74 per page for all published pages. Government institutions are expected to pay the full cost of publication. Authors must also be charged for their changes in proofs.

Limited journal funds are available to help offset publication charges to authors with minimal financial resources. Requests for financial assistance should be made to the Business Manager when the manuscript is accepted.

## Reprints

An order form for the purchase of reprints will accompany the galley proofs sent to the authors.

Francis R. Cook, Editor
RR 3 North Augusta, Ontario K0G 1R0

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### Book Reviews




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